Chapter 10

Customer Decision Making in Web Services

Zhaohao Sun

University of Ballarat, Australia

Ping Zhang

CSIRO, Australia

Dong Dong

Hebei Normal University, China

ABSTRACT

Web services play an important role in successful business integration and other application fields such as e-commerce and e-business. Customer decision making (CDM) is an indispensable factor for e-business and Web services. This chapter examines customer decision making in Web services. More specifically, it first looks at decision making in Web services, and proposes a novel P^6 model for CDM in Web services, which consists of 6 Ps: privacy, perception, propensity, preference, personalization, and promised experience. This model integrates the existing 6 P elements of marketing mix as the environment of customer decision making in Web services. The new integrated P^6 model deals with the inner world of the customer for decision making (DM) and incorporates what the customer sees and thinks during a DM process. The purpose of this novel P^6 model is to assist customers in the decision process to acquire the most satisfactory Web service. This chapter also examines case-based decision making in Web services and provides a theoretical foundation for case-based decision making under the condition of one problem with multiple solutions in Web services. The proposed approach will facilitate research and development of e-business, Web services, decision support systems, intelligent systems, and soft computing.

DOI: 10.4018/978-1-4666-0146-8.ch010

INTRODUCTION

Decision making (DM) is essential for the success of both e-commerce and web services (Sun, Wang, & Dong, 2010). Web services continue to play an important role in the success of business integration and other application fields such as e-commerce and e-business (Yao, Yang, & Su, 2006). Customer decision making (CDM) is an indispensable factor for web services, because customer decisions are critical factors for successful web services. Helander et al have analyzed the customer decision-making process in e-commerce (Helander & Khalid, 2000). The dramatic development of e-business and web services have enabled engaged customers to have a more informed process of DM in regards to selecting and purchasing goods and services online. Customers can now use web-based decision support tools such as search engines and infomediaries to break through the traditionally physical and geographical limitations associated with an international market and to reach globally provided products and services. This provides customers with a stronger bargaining position over prices of goods and the quality of services owing to the price and information transparency. However, there is also a big challenge for customer decision making in web services, that is, how to make decision under the condition of too many services or goods that are available online. O'Keefe and McEachern (1998) studied what parts of a customer decision process can be supported by web tools and customer decision support systems (DSSs). However, they did not discuss the inner world of the customers in decision making.

Customer decision making (CDM) is closely related to marketing and web based marketing systems (O'Keefe & McEachern, 1998). Marketing has usually been modelled by using the existing P6 model consisting of 6 Ps: price, people, place, process, product and promotion (Booms & Bitner, 1981; Chaffey, 2009). This P6 model evolved from the original P4 model of the marketing mix

introduced by McCarthy in 1960. McCarthy (1960) proposed that the marketing mix consists of 4Ps: product, price, place and promotion. McCarthy considered the marketing mix as an essential part of developing a marketing strategy (Chaffey, 2009:448). The existing 6 Ps are the external environment for CDM in web services from a system viewpoint, in other words, whenever a customer makes a decision on purchasing goods or services from on-line or e-services, she or he (for brevity, we use he to represent she/he hereafter) must consider or "see" some if not all of these 6 Ps. However, the weakness of these 6 Ps is symptomatic of a push approach to marketing and importantly does not recognise the needs of customers and the intrinsic role of participation of customers. In order to mitigate this weakness, Lantenborn (1990) integrated 4 Cs which are a mixture of customer's perception (Cost, Convenience), behaviour (Communication) and customer itself (Customer) to replace the P4 model. However, Lantenborn did not consider the relationship between CDM and the above-mentioned 4 Ps or 6 Ps. Sun et al proposed a C6 model by examining the 6 Cs for DM in web services, and argued that the 6 Cs: communication, competition, coordination, cooperation, collaboration and control play an important role in DM for all web service players (brokers, providers and requesters) in web services (Sun, Meredith, & Jia, 2009). The core idea behind the C6 model is to address what the web service players should "do" when they make decisions in web services. In other words, the 6 Cs in the C6 model are the activities that main players should do whenever they make decisions in web services. However, the existing models of e-business and e-services, at least to some extent, ignore what customers think when they make decisions in web services, although thinking and feeling are critical factors for customers to make any decision (Myers, 1962). Therefore, two issues arising from the above discussion are below:

- What do customers face or “see” in the decision environment when they make decisions on selecting and purchasing goods via online and or in web services?
- What do customers “think” when they make decisions on selecting and purchasing goods via online and or in web services?

This chapter addresses these issues by examining customer decision making in web services, proposing a novel P⁶ model for CDM in web services and looking at case-based decision making in web services. The rest part of this chapter is organized as follows: After providing a background on web services, decision making, and case based reasoning (CBR), the chapter first examines DM in web services and proposes a novel P⁶ model for CDM in web services by integrating the existing 6 Ps elements of marketing mix as an environment of CDM. This chapter then looks at each of the new 6 Ps and their relationships with the existing 6 Ps. It also summarizes the interrelationships between the new 6 Ps and the existing 6 Ps and discusses the relationships among the new 6 Ps. This chapter then examines case-based decision making in web services and provides a theoretical foundation for decision making under the condition of one problem with multiple solutions in web services. The final section concludes this chapter with some concluding remarks and future work.

BACKGROUND

This section provides a background on web services, decision making, and case based reasoning (CBR) and briefly incorporates them in customer decision making in web services.

Web Services

Web services are an emerging technology that enables disparate applications running on different

machines to exchange data and integrate with one another without requiring additional, proprietary third-party software or hardware (Papazoglou, 2008:3). Web services are also the most important applications of service-oriented computing. There are many different definitions for web services. For example, a web service is a self-describing, well-contained software module available via a network, such as an Internet, which completes tasks, solves problems or conducts transactions on behalf of a user or application” (Papazoglou, 2008:5). We like to use more general definition in this chapter: Web services are the provision of services over electronic networks such as the Internet and wireless networks (Sun, Finnie, & Yearwood, 2010). The main decision makers in web services are services providers, services brokers and services customers.

Decision Making

A decision refers to a choice that one make between two or more alternatives after thinking carefully (Turban & Volonino, 2010; Dictionary, 2007). More specifically, a decision is the point at which a choice is made between alternative- and usually competing-options (Dearlove, 1998). Decision making is a process of selecting from choices or alternatives for solving a problem or reaching a goal. Selection is at the centre of any decision making. A decision making process involves events or activities leading up to the moment of choice and beyond, whereas the decision is the final outcome of the process of decision making (Dearlove, 1998). A decision making process can be represented by a decision making lifecycle (DMLC). Customer decision making (CDM) is any decision making conducted by customers. CDM in web services aims to reveal what customers think, see and do whenever the customer makes decisions in web services in order to purchase or receive web services.

Case Based Reasoning (CBR)

Case-based reasoning (CBR) is one of the intelligent techniques for web services. CBR is a reasoning paradigm based on previous experiences or cases; that is, a CBR system solves new problems by adopting solutions that were used to successfully solve old problems (Sun & Finnie, 2004). Therefore, CBR is a kind of experience based reasoning. Experience based reasoning is a more general computing paradigm than CBR. CBR can be modelled using CBR cycle which consists of case repartition, case retrieval, case reuse, case revision, and case retention (Sun & Finnie, 2004). CBR provides customers with past experiences and support their decision making in workflow management (Weber, Wild, & Breu, 2004), e-commerce (Sun & Finnie, 2004), and web services (Sun, Finnie, & Yearwood, 2010). Case based decision making (CBDM) is any decision making using a strategy based on CBR such as "similar problems usually have similar solutions".

It should be noted that customer is a transitional concept in terms of web services, because a customer may at times play the role of a customer, at other times the role of a provider or when applicable the role of a broker. Therefore, in web services, one could always be termed as a customer. This is the reason that we use "customer" here, although what we discuss is also useful for DM of service providers and service brokers in web services (Sun, Finnie, & Yearwood, 2010). Furthermore, for brevity, e-services and web services are used interchangeably taking into account everything as a service (EaaS) in service computing (Singh & Huhns, 2005; Zhang, Zhang, & Cai, 2007). Although there are differences between e-services, web services, and infrastructure services, and they are at three different levels in hierarchy with e-services at the top level, web services in the middle, and infrastructure services at the bottom (Sun & Lau, 2007).

DECISION MAKING IN WEB SERVICES

This section first discusses decision making in web services taking into account web services providers, requesters and brokers. Then the section examines decision making lifecycle.

Decision making (DM) in web services has drawn an increasing attention to the web service community. For example, Yao et al discussed flexible decision making strategies for web service negotiation (Yao, Yang, & Su, 2006). Denning and Hayes-Roth (2006) investigated DM in very large networks and concluded that decision makers should learn how to share situation information and to make decisions locally through market-like mechanisms that focus resources on high-value activities. Unlike most daily decisions, decision making in web services involves important trade-offs in terms of quality of services and cost of services in some cases. DM in web services means that a decision maker chooses one of the web services from the alternative recommended web services provided by a web service support agent. One may think that DM in web services is needed at only one stage of the web service lifecycle such as the recommendation stage, but it is actually a fundamental activity involved within every stage of the web service lifecycle (Sun, Meredith, & Jia, 2009). Consequently, a chain of decision making is formed in web services. In what follows, we will not look into the process of DM within every stage of the web service lifecycle; we will examine what decisions the decision makers make in web services in some detail.

There are three main parties or players in web services: web services providers, requesters, brokers and their corresponding intelligent agents (Guruge, 2004; Singh & Huhns, 2005; Sun, Finnie, & Yearwood, 2010; Sun, Wang, & Dong, 2010). Decision makers in web services are mainly web services requesters, providers and brokers.

A web service requester or customer makes decisions to acquire the most satisfactory web

services with minimal costs (Sun, Finnie, & Yearwood, 2010). For example, the service requester or customer should make a decision for web service use, which consists of web service identification, alternative generation, and execution (Kwon, 2003). In the era of the Internet and WWW, the web service customers want and expect personalized products or web services, which lead to "mass customization". This can be achieved by using easy-to-change computerized manufacturing systems. The Internet and web-based systems make such a mass customization possible and successful, as practiced by Dell Computer Corp (Turban & Volonino, 2010).

The decision in web services made by the service provider is to provide the highest quality web services with maximal expected benefit (Sun, Meredith, & Jia, 2009). For example, the service provider should make informed decisions for selecting the updated standards, technologies, and tools for representation, orchestration, publication, registry of web services.

The decision in web services made by the service broker is to provide the highest quality web services with maximal expected benefit from the service provider and service requester (Sun, Finnie, & Yearwood, 2010). For example, the service broker should make decision for web service personalization (retrieval and discovery), composition, negotiation and recommendation.

More generally, all the involved decision makers in web services should have useful information and services from web services and the database and knowledge base technologies to make decisions (Kwon, 2003), they also share open decision modules on the Internet using standardized protocols such as HTTP, SOAP, and WSDL and so on. Various intelligent techniques such as soft computing and multiagent system technology are widely used to facilitate decision making in web services (Sun, Wang, & Dong, 2010).

In order to make these decisions, customers in web services should follow a certain decision making process that can be considered as a deci-

sion making lifecycle, which will be described below in some detail.

Decision making lifecycle (DMLC) describes a decision making process that starts with a planning procedure from decision makers, follows by steps of selecting an optimal solution or action for a given problem from available choices, and ends with the selected action to solve the given problem. According to Simon (1977:40-41), a DMLC consists of four phases: intelligence, design, choice and review.

In the intelligence phase, the decision maker searches environment for conditions calling decision to solve a given problem. He defines the problem and identifies the goals and objectives.

In the design phase, the decision maker finds possible courses of actions through identifying, inventing, developing and analysing various alternatives (Gao, Wang, Xu, & Wang, 2007). A model is constructed and validated, evaluation criteria are set in this phase.

In the choice phase, the decision maker selects a particular course of action based on the results of design phase (Turban & Volonino, 2010). In this phase, the decision maker also considers what criteria to use, what is the best solution, what is a good action and so on.

In the review phase, the decision maker assesses or evaluates the past choices or decision made in the choice phase or in the past to solve similar problems.

It should also note that the foregoing mentioned DMLC is generic. Applying it to web services requires some specification. In other words, we should consider some details when we look at each of the four phases of the DMLC in web services.

According to O'Keefe and McEachern (1998), a DMLC of a decision maker in general and a customer in web services in special consists of web service need recognition, information search, evaluation, purchase and after purchase evaluation:

Customer Decision Making in Web Services

- Need recognition. A decision maker must recognise that he has needs which can be satisfied through purchasing web services. This corresponds to the above mentioned intelligence phase.
- Information search. The decision maker then searches for a product or service that satisfies the recognised need, along with outlets that can provide it. This corresponds to the above mentioned design phase.
- Evaluation. The decision maker uses decision heuristics to evaluate and compare the goods or services in the terms of price, quality of services and so on. This also corresponds to the above mentioned design phase.
- Purchase. The decision maker places an order, pays for the evaluated goods or services, and possibly arranges for collection, delivery or maybe installation; which corresponds to the above mentioned choice phase.
- After purchase evaluation. The decision maker evaluates the purchase with a view to future decision making, and this corresponds to the above mentioned review phase.

Now we illustrate the above DMLC with a real example. John and his wife intended to buy a house recently. They did not visit any real estate companies located in the downtown but search for online real estate companies. They found a famous online real estate company meeting their needs for buying a house in their living city, and therefore, they completed the first phase of a DMLC, need recognition. They then visited this website and searched the houses with their criteria: 3-bedroom, 2-bathroom. The website provided them with 210 houses meeting their needs. In this case, they had to evaluate or assess each of these houses by doing virtual tour of the house, reading the detailed information on these houses. This is the design phase of the DMLC. Finally, they

decided to buy a house taking into account the distance between the house and their work place, age of the house, etc. This is the choice phase of the DMLC. After buying the house, one of their friends told them that the price they paid for the house was higher than it could be, because they did not inspect another available house carefully. This is the review phase of the DMLC.

P⁶: AN INTEGRATED MODEL FOR CDM IN WEB SERVICES

As mentioned in the Introduction Section, the existing 6 Ps of marketing mix (Chaffey, 2009) reflect the environment of decision making in which the main players of web services make decisions on web services. However, from a customer perspective, the question remains: what are the inner activities of customers when they face their environment consisting of the above mentioned 6 Ps to make decisions? The activities represented by the newly introduced 6 Ps are as important as the 6 Cs (communication, competition, coordination, cooperation, collaboration and control) provided by Sun et al (2009) for CDM process in web services, because the former is a reflection of what the customer thinks whereas the latter are what the decision makers should do in web services. These new 6 Ps are approaching the inner world of the customers for DM in web services.

This section proposes a novel P⁶ model which integrates the existing 6 Ps and the new 6 Ps into CDM process in web services, as shown in Figure 1.

In this integrated model, the core is customer decision making (CDM) in web services. The intermediate ring consists of the newly introduced 6 Ps: privacy, perception, preference, propensity, personalization and promised experience. The external ring is the existing 6 Ps: price, people, place, process, product and promotion (Chaffey, 2009), which form the environment of customer decision making in web services. The newly in-

Figure 1. *P⁶: An integrated model for CDM in Web services*

roduced 6 Ps play an important role in CDM process in web services. For example, if a customer has not any propensity of buying a book on Information Systems, then would he care about price, place, or other elements listed in the existing 6 Ps? The answer is certainly “No”. Therefore, the first step for any CDM in web services is to know what the customer is thinking about. In what follows, we will examine the decision making environment of customers in web services and what the customers think whenever making decisions in web services to some detail.

THE EXISTING 6 Ps: DECISION MAKING ENVIRONMENT OF CUSTOMERS IN WEB SERVICES

From a system perspective, marketing is the environment where the customers or service requesters can obtain the goods or services. The above-mentioned existing 6 Ps reflect the envi-

Figure 2. *The existing 6 Ps as the decision making environment for customers in Web services*

ronment in which the customers make decisions on web services as illustrated in the proposed model, shown in Figure 2. These 6 Ps are the core elements of what the customers “see” whenever making decisions in web services. Furthermore, the existing 6 Ps have been, to some extent, described in many textbooks on marketing and e-commerce such as Chaffey (2009) and Awad (2007). It seems from past readings that these

texts are placing more emphases on the existing 6 Ps from a perspective of company rather than from the perspective of customers. In what follows, we will describe each of the existing 6 Ps from the perspective of customers.

Product

The product can be defined as either physical goods or services in e-business and web services. For example, books sold by fishpond.com.au are physical goods. E-journals provided by Elsevier.com are digital services. When making a decision on purchasing a product, a customer always looks at the product's quality, features, branding, associated customer service, warranty, reliability and the integrity of the product (Awad, 2007:275). In the Internet era, researchers need not read many journal articles in the form of hard copy, and they tend to read journal articles online, which themselves are a kind of service product. One of the characteristics associated with the web services different from the traditional services is that the product presented online is available globally to the more than two billion Internet users without limitations of time and distance. Therefore, the global transparency of a product dramatically increases the choice space for a customer to make decisions in web services.

Price

Once the customer has intention of buying a product or service online, the next step is to make decision based on the prices and the affordability of the customer for purchasing the product and service. Internet technologies have significantly increased the diversity of prices. For example, in the past a customer would purchase an air-ticket for a flight from Sydney to Melbourne at a very high price without other choices. Nowadays, he can buy an air-ticket at a very low price by quickly accessing different flight vendors and comparing prices online. The global price transparency in

e-business and web services greatly helps customers to select goods or services at relatively low prices. For example, in the majority of cases, the price for a book on intelligent systems from <http://www.amazon.com> is much higher than that from Australasia's biggest online store, <http://www.fishpond.com.au/Books>, in particular for an Australian customer. Therefore, Australian customers would like to buy a book from <http://www.fishpond.com.au/Books> online at a lower price. Moreover, pricing of web services or e-commerce differ with the market, and the type of customer (Awad, 2007:274). For example, google.com provides an individual customer with free search, translation, and reading of books. This is a kind of free services online. However, a big company has to pay for the search and special online services provided by google.com.

People

As proposed earlier, people involved in the web services mainly include service providers, service requesters and service brokers. More generally, all business agents and intelligent agents that help selection and delivery of services from service providers to service requesters (customers) are related to the customer for his decision making in web services (Chaffey, 2005:464). The intelligent agents (Singh & Huhns, 2005), for example, include autoresponders, e-mail notification, frequently asked questions (FAQs), online search engines and virtual assistants such as infomediaries and credit card information receivers. A customer can see and interact with physical people to make decisions. The customer can also interact with the intelligent agents to make decisions in web services to buy goods and services. With the development of the Internet, more and more intelligent agents including decision support systems (Turban & Volonino, 2010) are involved in the web services and help customers to make decisions, and facilitate customers to buy goods and services online.

Place

Place involves distributing products or services to customers in line with demand and minimizing the costs involved with inventory, transport and storage (Chaffey, 2009:460). The Internet has affected the importance of place in the context of CDM in web services. For example, in the past, an academic staff member had to visit the university library physically to borrow the *Journal of Artificial Intelligence* or *Journal of Soft Computing*. Nowadays, he simply sits in the office to access the corresponding e-journals of *elsevier.com* and *springer.de* and read the selected articles. Therefore, the distance between the office and the product or service provider becomes almost zero. Online presence of the goods or services also shortens the physical distance between the customer location and the place where the goods or services are provided from. For some goods or services such as digital journals and computer games, a customer can get what is seen on the website where the goods or services are present.

Process

From a company perspective, process involves the methods and procedures that companies use to achieve all marketing functions (Chaffey, 2009:464). From a customer perspective, process involves all the stages that a good and the service can transfer from the providers to the customer. The stages in the process include the access of the good or service presence, the good or service request submission and processing, the payment and confirmation for purchasing the good or service, the delivery of the good or service to the customer. Whenever making decision for purchasing a good or service, the customer concerns the efficiency and effectiveness of the process involved in the good and service.

Promotion

Promotion involves communication with customers and other stakeholders to inform them about the product and the organisation (Chaffey, 2009:462). From the perspective of companies, promotion in e-business usually follows the AIDA (attention, interest, desire, and action) (Awad, 2007:275), that is, the first phase of promotion is to attract the attention of the prospective customers to the good or service, because attention is the entry point for marketing process. Good graphics, attractive banners, and proper use of colour are essential to draw customers' attention. The interest phase is to attract customers' interest in the good or service available on the websites. The desire phase is to build desire from customers for actions. The final decision for buying a good or service is the action. From the perspective of a customer, whenever making decisions, the customer has an instinct of doubting any promotion from the service providers and he usually collects promotion information for similar services from different providers. It is often the case that a customer does not buy the good and service although he has had attention, interest and desire.

THE NEWLY INTRODUCED 6 Ps: INNER ACTIVITIES OF CUSTOMERS FOR DECISION MAKING IN WEB SERVICES

This section will examine each of the newly introduced 6 Ps involved in the proposed model in some detail. These 6 Ps are the core elements of what the customers "think" whenever making decisions in web services.

Privacy

Privacy is the right of an individual to control the information held about them by third parties (Chaffey, 2009:209-222). Privacy of personal and

valuable information such as IDs, credit card information, propensity and income is a major concern to most consumers interacting with e-business and web services. Legitimate concerns regarding privacy remain potential obstacles to growth and important issues to both customers and providers (Liu, Marchewka, Lu, & Yud, 2005). Privacy has been stipulated and incorporated into many laws related to e-business, web services such as Privacy Electronic Communication Regulations (PECR). Privacy was a big issue when web services began and it continues to be a major issue within e-services in the future. The key idea behind it is that a customer has to make a trade-off between privacy and convenience in e-business and web services, that is, how much private information a customer will allow the third parties to access and collect in order to get a returnable benefit from e-commerce and e-services (Sun, Sun, & Meredith, 2010). In CDM, only two of the existing 6 Ps are related to privacy: people and promotion. For example, if a customer is buying an air ticket online, he is primarily concerned about the reliability of online payment system (promotion and people).

Perception

Perception is a particular way of understanding or thinking about something (Dictionary, 2007). Customers' perceptions about e-commerce and web services have drawn increasing attention to information systems and e-commerce management. Common literature on e-commerce usually looks at buyers' perceptions of the sellers' competence, integrity, and benevolence (Goel & Prokopec, 2009). Goel and Prokopec (2009) examined customer's perceptions of trust, product diagnosticity, informativeness, and product description in websites and virtual worlds, and they concluded that there is a significant difference within customer's perceptions between interacting with websites and virtual worlds. In web services, customers usually perceive all of the existing 6 Ps. For example, when a customer makes a deci-

sion on which book on artificial intelligence (AI) to buy, his DM process normally includes the following steps: 1) think about how much is the book (product, price); secondly, 2) check where the book is published (place); 3) read and assess the cover pages (promotion); and 4) consider who are the authors of the book and the qualification of the authors (people). 5) consider how long he can receive the book (process). This seems to be a very logical process for customers to follow (Sun, Sun, & Meredith, 2010). This is a reason why customers consider the existing 6 Ps as their decision making environment in web services.

Preference

Preference refers to the set of assumptions relating to a real or imagined "choice" between alternatives and the possibility of ranking the order of these alternatives, based on the degree of happiness, satisfaction, gratification, enjoyment, or utility they provide (Dictionary, 2007; Wiki, 2010). Typically, different customers have different preferences (Gilboa & Schmeidler, 1995). In web services, a customer's preferences are related to all the existing 6 Ps: product, price, place, promotion, people, and processes. A customer could be very happy with the preferable price of an e-service and simply satisfied with the preferable product in some cases. Place still plays some role in web services. For example, if a customer buys a book on business intelligence using amazon.com, he pays much less transportation fee for delivery in America than in Australia.

Propensity

Propensity is a natural tendency to behave in a particular way (Dictionary, 2007). The propensity of customers engaging within e-commerce and web services has been changed dramatically during the Internet era. For example, the propensity of customers to purchase products using traditional channels such as phone or in store has gradually

reduced during this period (Chaffey, 2009:463). More and more customers like to use the Internet to buy air-tickets and books and so on. Propensity is directly related to perception of customers, and it is also affected by all the existing 6 Ps. In particular, promotion, one of the existing 6 Ps, through advertisements and other media including online social networks has been always influencing the propensity of customers and their DM in web services. The intermediaries (people) or infomediaries (intelligent agents) have also been using various tools, systems and strategies to influence the propensity of customers and their DM in web services.

Personalization

Personalization has drawn increasing attention to the development of web services, because the customers currently want personalized products or web services (Turban & Volonino, 2010:343). In fact, personalization has been an indispensable element of customer relationship and of web strategies in e-business and web services (Fan & Poole, 2003). The key idea behind the personalization of web services is to treat customers based on their own personal preferences. Furthermore, personalization requires that different web services target different people from different backgrounds and demographics. Personalization softwares provide one-to-one recommendation of products and services to customers (Awad, 2007:278).

There are many different definitions of personalization in the literature. Fan and Poole (2003) investigated perspectives on personalization in a more general sense. Personalization has been defined from the perspectives of different disciplines such as marketing/e-business (Awad, 2007), cognitive science, sociology, computer science, anthropology and architecture. In web services, personalization is the capability to provide customers with the most relevant web experience possible from the viewpoint of commerce (Sun, Sun, & Meredith, 2010). Personalization is considered as

a toolbox of technologies and applications used to design the end-user experience from the viewpoint of system development. It is a consumer-centric infomediary that acts on behalf of users to perform online shopping, searching and information gathering services from a viewpoint of computer science (Fan & Poole, 2003). Chaffey (2009:528) considers personalization as the customization of information requested by a site customer at an individual level. Personalization of customers can be achieved through several dynamic variables including customers' preferences, date or time, particular events and location, and the existing 6 Ps.

Promised Experience

Online customer experience is a combination of rational and emotional functions via the use of a company's web services that influences customer's perceptions on web services (Chaffey, 2009:625). Promised experience is a kind of online customer experience. It is strategically important for CDM in web services, because only promised experience can really influence CDM in web services.

Promised experience can be direct experience (Sun & Finnie, 2004; Sun & Lau, 2007) or sometimes it is presence (Chaffey, 2009), and sometimes it can be indirect experience, which is more popular in web services. Promised experience is associated with trust. For example, if agent B trusts agent A closely, then agent A tells agent B what he experienced when buying a book from amazon.com, which can be considered as a promised experience from the viewpoint of agent B. Agent B will decide if he also wants to buy a book from amazon.com based on the promised experience from agent A. In this case the promised experience is a critical factor for agent B's DM in web services. This is also the reason why there are many customer relationship management (CRM) systems developed for managing customer experience and let customers obtain promised experiences (Turban & Volonino, 2010),

Table 1. Interrelationships between the existing 6 Ps and the new 6 Ps

6P	Product	price	place	people	promotion	Process
Privacy				X	X	
Preference	X	X	X	X	X	X
Perception	X	X	X	X	X	X
Propensity	X	X	X	X	X	X
Personalization	X	X	X	X	X	X
Promised experience	X	X	X	X	X	

which is also a fundamental factor for perception of customers in web services.

INTERRELATIONSHIPS BETWEEN NEW 6 Ps AND EXISTING 6 Ps

This section summarizes the interrelationships between the existing 6 Ps and the newly introduced 6 Ps in the context of CDM in web services, as shown in Table 1.

In fact, the discussion in the previous section shows that there are a number of interrelationships between the newly introduced 6 Ps (listed in the first column of Table 1) and the existing 6 Ps (listed in the first row of Table 1), as illustrated in Table 1. For example, personalization is an important technology in e-marketing (Awad, 2007:273-278). Customer personalization is strongly affected by product, place, pricing and promotion (Awad, 2007:273). Personalization can also enhance promotion and product (Awad, 2007:279).

Furthermore, the newly introduced 6 Ps are closely interrelated to each other. For example, the preference of customers is determined by the customer's promised experience. They both influence the perception and propensity of a customer on a web service. Personalization requires detailed information on preference, perception, propensity, and promised experience of customers. Personalization also makes trade-off between privacy of customers and the convenience for customers.

Based on this discussion, personalization is not only behaviour of the organisation or system development but also behaviour of customers in web services. Customers also prefer to obtain personalized e-services.

There might be two common problems arising for the proposed model.

- Why are these new 6 Ps rather than other 6 Ps selected for CDM process in web services?

Based on the literature review, we have tried to use other P(s) to replace some if not all of the proposed 6 Ps. For example, presence is an important element for any DM (Chaffey, 2009). However, presence is not most important in web services, different from that in traditional commerce or services. In fact, presence can be considered as a part of promised experience.

- Why do you select 6 Ps rather than other number of Ps?

From a model perspective, 4, 5, 6, 7, 8 even larger can be used to create a model for marketing (Chaffey, 2009), e-business (Sun, Meredith, & Jia, 2009) and case-based reasoning (Sun & Finnie, 2004) and so on. Six is a neither large nor small number for creating a practical model for CDM in web services. A larger number of Ps will take more space, and too many Ps would complicate the model.

So far we have examined what customers see in the DM environment and what they think whenever making decisions in web services. In fact, one of their decision making strategies lies in “similar services have similar prices”. This is a kind of case-based decision making, which will be examined in some detail in the next section.

CASE BASED DECISION MAKING IN WEB SERVICES

This section examines case-based decision making in web services and provides a theoretical foundation for decision making under the condition of one problem with multiple solutions in web services, taking into account case-based web services for discovery, composition and recommendation.

Introduction

Case-based reasoning (CBR) is a reasoning paradigm based on previous experiences or cases; that is, a CBR system solves new problems by adopting solutions that were used to successfully solve old problems (Kolodner, 1991; Sun & Finnie, 2004). Ladner et al (2008) used case-based classification for web service discovery by applying CBR to supervised classification tasks. Kwon (Kwon, 2003) examined how to find the most similar web service case among cases using CBR. Sun et al provided a CBR model for unifying the processes of service discovery, composition and recommendation in web services (Sun, Wang, & Dong, 2010). CBR has been successful in making recommendation of business activities such as in e-commerce to recommend different e-services with high QoS (quality of service) (Sun, Wang, & Dong, 2010). However, how to make decision in web services using CBR still remains open for CBR research. The following subsections will address this issue.

Web Services vs. CBR

A case in case base in the context of CBR is denoted as $c = (p, s)$, where p is the structured problem description and s is the solution description (Sun & Finnie, 2004). In web services, the service case base stores the collection of service cases (Sun, Wang, & Dong, 2010). A service case, $w = (d, f)$, consists of the service description d and its service solution (or functions) f as well as other information including functional dependency among web services. The service description corresponds to the requirement of the service user, while the service solution corresponds to the answer to the requirement. In this way, a web service case in web services corresponds to a case in a case base (Sun, Wang, & Dong, 2010).

When service definitions change or new providers and new services are registered within the web services platform, the services need to be adaptive to the change in the environment with minimal user intervention, in order to manage and even take advantage of the frequent changes in the service environment. In other words, web service adaptation is necessary for web services. In fact, case retrieval (search), reuse, revise (adaptation) and retention constitute the basic activities of a CBR cycle (Sun & Finnie, 2004). Web service retrieval (search), reuse, adaptation, and retention in web services can then correspond to the activities of CBR. Therefore, at a general level, CBR can be used for processing web service retrieval, reuse, adaptation, and retention, implying that CBR is naturally applicable to web services. This is the reason why CBR has been successfully applied to web service discovery (including search and matching), composition and recommendation (Sun, Finnie, & Yearwood, 2010).

Case-Based Decision Making in Web Services

Case based decision making (CBDM) is a decision making using a strategy based on case based

Table 2. Prospective houses that might be bought by John and his wife in 2011

House No	Bedrooms (no.)	Bathrooms (no.)	Car spaces (no.)	Suburb	Price (\$1000)	Other features
001	3	2	2	Sebastopol	295	3 Jess Way
002	4	2	2	Sebastopol	280 - 295	330VickerSt
003	3	2	2	Sebastopol	315	11 DamonCt
004	4	2	2	Sebastopol	285 - 312	6 Luka Ct
006	3	2	2	Sebastopol	279- 289	21 Carmichael
007	3	2	1	Sebastopol	242	92 Tait St
008	4	2	2	Mt Clear	345- 355	18 HorwoodDr
009	3	2	1	Mt Clear	295 - 305	15 Muller Court
010	3	2	2	Mt Clear	299.5	23 OlympicAv
011	4	2	2	Mt Clear	330-360	16 Rodney Av

(Note that Table 2 is based on the real data from <http://www.realestate.com.au/>, in February 2011).

reasoning (CBR) such as “similar problems have similar solutions”. CBDM was originally from case-based decision aiding to improve human decision making, proposed by Kolodner (1991). The idea of case-based decision aiding is that the computer augments the person’s memory by providing cases to solve a problem. The person makes decisions using these cases as a guideline, which are case-based decisions. Gilboa and Schmeidler (1995) proposed CBDM as a part of case-based decision theory. Hüllermeier examined CBDM based on possibilistic theory (Hüllermeier, 1999) and provided a theoretical foundation for case-based decision theory (Hüllermeier, 2007). Nowadays, case-based decision making has become a new paradigm for decision making under uncertainty by combining CBR with decision theory. CBDM has achieved some success in web services, Ethics, Human Computer Interaction, Intelligent Decision Support, Law, Finance, Patient Management and Medical diagnosis (Bellazzi, Montani, & Portinale, 1999; Hüllermeier, 2007). For example, Kwon (2003) argues that with the dramatic increasing of the number of available web services, CBR is very helpful for finding web services if the customer has no choice by to collect information from scratch. However, it has not been successful

in solving problems with multisolutions, which are very common in decision making in web services, management, and engineering. This subsection will address this issue and propose a novel perspective on similarity in CBR. It will also provide a theoretical foundation for CBDM under the condition of one problem with multiple solutions in web services.

Before exploring into CBDM in web services, we first formalize the example mentioned earlier in this chapter as Table 2 (based on <http://www.realestate.com.au/>), which has drawn attention to John and his wife. As mentioned earlier, their big interest is to buy a house with the condition of “Bedrooms ≥ 3 and Bathrooms = 2”. Therefore, the prospective houses that might be bought by John and his wife in 2011 are listed in Table 2.

From the viewpoint of John and his wife, they have the following formations:

- Sebastopol is the surrounding suburb of Mt Clear, and then for buying a house, Sebastopol is similar to Mt Clear. If we use $\approx$ as a similarity relation among suburbs for buying a house, then

Sebastopol $\approx$ Mt Clear

- If we use $\sim$ as another similarity relation to assess the similarity among houses that John and his wife are trying to buy. Then, we have the following similarity class based on Table 2. A case is identified by the house No. here. The set of cases similar to case 001 is denoted by $[001]_{\sim}$, which is a similarity class with the representative element 001 (Sun & Finnie, 2004).

$$[001]_{\sim} = \{003, 006, 007, 009, 010\} \quad (1)$$

In other words, $001 \sim 003 \sim 007 \sim 009 \sim 010$. This means that for John and his wife, house 001 is similar to house 003, and house 003 is similar to house 007, etc.

This example motivates us to rethink about similarity in CBR, different from Hüllermeier (2007) and Sun & Finnie (2004).

- Similarity $\sim$ is a weak form of identity or equality $=$.
- Similarity is an observed equality from a special viewpoint of an observer. For example, if John and his wife are only interested in a house with Bedrooms = 3, Bathrooms = 2, then they believe that house 001 is similar to house 003, and house 003 is similar to house 007.
- From the viewpoint of database systems (Rob & Coronel, 1997), similarity classes can be obtained by filtering through Select, one of the relational database operations as follows:

Select *

From House

where Bedrooms = 3, Bathrooms = 2

The result of the Select is the above-mentioned $[001]_{\sim}$. In this way, we establish a relationship between similarity operator and the Select operation of relational databases, which has not been given, to our knowledge. So far, we have not yet used DM, if the central action of any decision

making is selection among the choices or alternatives. If John and his wife select house 006 from (1), then they make a decision. In other words, CBDM includes not only CBR but also selection of choices based on decision theory. From a similarity-based reasoning viewpoint, if John and his wife believe that $[001]_{\sim}$ consists of too large number of alternative houses for selection, they decide to add another feature for the house to be bought, that is, car spaces = 2. In this case, we still use $[001]_{\sim}$ to denote the similarity class from the viewpoint of John and his wife for buying a house as follows:

$$[001]_{\sim} = \{003, 006, 010\} \quad (2)$$

Normally, one might have more than 100 houses for selection from online real estate website when searching for a house to buy. In this case, reducing the selection space becomes significant. The feature of this selection space reduction is: The more features the customer considers in the decision making, the less the size of similarity class is. Repeat such a reduction process until at one step in which the similarity class consists of one element, which is the action selected for decision if the decision maker likes to make decision. The process is case-based decision making, that is:

$$\text{case-based decision making} = \text{CBR} + \text{decision making} \quad (3)$$

More generally, the process of case based decision making (CBDM) in web services can be treated formally as following steps:

1. Problem definition: The web service customer's question is normalized into a structured service description p_0 , for example, buy a house with 3 bedrooms and 2 bathrooms.
2. Case retrieval. The CBR system uses its similarity mechanism to retrieve its service case base, which consists of service cases, each of which is denoted as $c = (p, s)$, where p is

the structured service problem description, and s is the service solution description. For example, p_0 can be “a house with 3 bedrooms and 2 bathrooms”. The inference engine of the CBR system performs similarity-based reasoning that can be formalized as (Sun & Finnie, 2004):

$$p_0, p_0 \sim p, p \rightarrow s \models s \quad (4)$$

where p_0 , p , and s represent fuzzy compound propositions, $p_0 \sim p$ means that p_0 and p are similar in terms of fuzz logic.

From the viewpoint of fuzzy CBR, the service case retrieval process from web services search and matching is used to discover the following service cases from the web service case base in the CBR system (Sun, Wang, & Dong, 2010):

$$C(p_0) = (c_i | c_i = (p_i, q_i), p_0 \sim p_i) = \{c_1, c_2, \dots, c_n\} \quad (5)$$

This is the result of *case based web service discovery or retrieval*, where n is a positive integer, $c_1, c_2, \dots, c_n$ are all service cases with their problem description p_i ($i = 1, 2, \dots, n$) similar to the current demand description p_0 (Sun, Finnie, & Yearwood, 2010). For example, the above mentioned $[001]_- = \{003, 006, 007, 009, 010\}$ is an instantiation of $C(p_0)$ in (5). To this step, the process can be considered as CBR.

Note that if $n = 0$, then the CBR system might encounter the cold start problem (Mehta, et al, 2010), which will be described later in this chapter. This is the first theoretical result for the cold start problem.

3. CBDM-I. In order to do CBDM, all service cases $C(p_0)$ should be prioritized in descending order as $\{c_1, c_2, \dots, c_n\}$ and satisfies the following property: for any integer i , $1 \leq i \leq n$ and $c_i = (p_i, s_i)$,

$$m(p_i, p_0) \geq m(p_{i+1}, p_0) \quad (6)$$

where $m(\cdot)$ is a similarity metric, which measures the similarity between one service demand and another (Sun & Finnie, 2004). Then $c_1 = (p_1, s_1)$ might be selected as the solution to the problem p_0 . This is a step of case-based decision making, centred by selection of a choices.

It should be noted that “more similar problems have more similar solutions” is not always true, although “similar problems have similar solutions” is the principle of CBR. Therefore the selection of $c_1 = (p_1, s_1)$ as the result of CBDM lacks theoretical foundations. In the most CBR systems in the literature, Equation (6) is specialized into

$$m(p_i, p_0) = m(p_{i+1}, p_0) \quad (i = 1, 2, \dots, n) \quad (7)$$

This has also happened in the above-mentioned example, in which $m(p_i, p_0) = 1$, $i = 1, 2, \dots, n$. In this situation, the process of CBDM is to select one from $C(p_0)$ as the best solution to the problem p_0 of the web service customer.

4. CBDM-II. In this step there are two possibilities: The first possibility is to increase the attributes of the problem p_0 to reduce the size of $C(p_0)$ as we did in the above example. Another possibility is to introduce the utility function and assign a utility value to each of service cases $C(p_0)$ retrieved by the CBR systems as follows: a utility function $u: P \times S \rightarrow R$ is introduced, and assigns a utility value to each of selected cases in Equation (5) (Hüllermeier, 2007:255), we have

$$C(p_0) = (c_i | c_i = (p_i, q_i, u_i), p_0 \sim p_i) = \{c_1, c_2, \dots, c_n\} \quad (8)$$

Where u_i can be considered as an overall assessment result of John and his wife taking into account what they “see” in the decision making environment consisting of the existing 6 Ps, and what they think about in the context of the newly introduced 6 Ps. Then the decision maker selects the case with the largest utility value and

ends the CBDM. For example, John and his wife made the decision and finally bought the house 006 based on their assigned utility value to each of the selected house [001] : u_i (house 001) = 0.78, u_i (house 003) = 0.8, u_i (house 006) = 0.98, u_i (house 007) = 0.68, u_i (house 009) = 0.75, u_i (house 010) = 0.77.

After completing Step 4, the CBDM realized

$$p_0, p_0 \sim p, p \rightarrow s, s \approx s_0 \models s_0 \quad (9)$$

where $s \approx s_0$ means that s_0 and s are similar in terms of fuzz logic (Sun & Finnie, 2004). This also demonstrates that CBDM is a decision making that selects choices based on the principle of CBR.

Based on the above discussion, the utility function and utility value are not necessarily introduced until CBDM-II is executed. To our knowledge, this is the most concise explanation for CBDM so far, and it improved the work of Kolodner (1991), Sun and Finnie (2004), and Hüllermeier (2007) in the context of CBR and CBDM.

SOLUTIONS AND RECOMMENDATIONS

We have examined CDM in web services and provided a theoretical foundation for case-based decision making (CBDM) under the condition of one problem with multiple solutions in web services based on our early works and literature review. It is significant for understanding of the proposed approach and its usability to provide practical implementation in the near future. In the business area, many models are proposed by global consultation companies. For example, McKinsey 7S framework was developed in the early 1980s by Tom Peters and Robert Waterman, two consultants working at the McKinsey & Company consulting firm. As scholars, we can also develop our model for CDM in web services based on existing 6 Ps and newly introduced 6 Ps. In fact, we have used this model in our teaching

e-business management successfully for understanding CDM in web services and e-business.

In examination of CBDM, we proposed a novel approach to “similarity without any computation”, different from existing similarity measures such as used by Weber, Wild and Breu (2004), or examined by Sun and Finnie (2004), or Hüllermeier (2007). We examine similarity first as a binary relation, which is without any computation. Therefore, similarity without computation or similarity without metrics is a challenge for computer science, database, CBR and web services.

In the past few years, CBR researchers have encountered obstacles of CBR such as cold start problem: a CBR system may fail to provide any suggestions to the user if it has not past experience or its initial cases are not populated manually (Mehta, et al, 2010), which corresponds to the result of case retrieval when $n = 0$ in this chapter. The recommender systems also face the similar problem: When a new item enters the system, while the number of ratings on this item is low, it cannot be recommended to users (Brun, Castagnos, & Boyer, 2011). Mehta, et al (2010) proposed an intelligent planner which uses modified genetic algorithm assisted CBR to solve the cold start problem, whereas Brun, Castagnos, and Boyer (2011) proposes mentor and leader detection to alleviate the cold start problem in recommender systems. With the development of system prototypes based on the proposed approach in this chapter, one certainly addresses this problem. The cold start problem in case based recommendation or CBDM may be related to similarity, “similarity without computation” can integrate case base with database, and might provide a method for mitigating the cold start problem.

CBR is one of the intelligent techniques for making web services more intelligent. In fact, there are many intelligent techniques for making web services intelligent, which at least include fuzzy logic, data mining, multiagent systems, to name a few. Any attempt of applying intelligent techniques to web services is significant. For

example, one can examine CDM in web services in the future work taking into account workflow management (Weber et al, 2004).

FUTURE RESEARCH DIRECTIONS

Decision making is closely related to mental activities of customers in web services. What customers “see” in the decision making environment of web services, and what customers think about the products and services online are only a necessary condition for the decision making of customers. It is often the case that a customer has seen and thought about a million services and finally do not buy any services online. Therefore, what the customer should do when making decisions in web services become a big issue. Furthermore, what are the interrelationships among what customers see, what customers think about and what customers should do whenever making decisions is a future direction for research and development of CDM in web services.

Decision making techniques and tools are important for CDM in web services. Therefore, decision making techniques and tools based on DMLC in web services are an interesting topic for future research direction, because they are also the basis for developing any system facilitating CDM in web services.

CBDM has drawn attentions in finance, medical diagnosis. However, a big issue is “Will case-based decision makers be successful in web services?” This is similar to “will case-based decision makers survive in a financial market (Guerdjikova, 2004)?” The answer for them is “No” in the majority of cases in either financial market or web services. This motivates us to think about decision making strategies of customers in web services, as decision making is usually related to decision making strategies. Decision making strategies are general principles or guidelines for a concrete decision making. For example, CBDM only complies with one of the decision making

strategies, that is “similar problems have similar solutions” in general and “similar services have similar prices” in web services in special. However, in reality, we have also three other decision making strategies besides the above mentioned, which are derived from CBDM: “similar problems have not similar solutions”, “non-similar problems have similar solutions” and “non-similar problems have not similar solutions”. For making any decisions in web services, we should use all these four decision making strategies based on CBR. Otherwise, our decision making is incomplete. This lead to two issues: *decision making strategies* and *incomplete decision making* (Note that it is different from decision making with incomplete information). Incomplete decision making means that the decision has been made without taking into account *all related decision making strategies*, and all related situations, occasions, information, etc. (for brevity, it can be called decision making with incomplete strategies). Such incomplete decisions implicate risk and failure whenever we undertake further actions based on the decision made. Therefore, for a given problem, what are all the decision making strategies should first consider is an interesting topic for the future research in decision making in web services in special and decision making in any other fields in general.

CONCLUSION

This chapter investigated customer decision making in web services and proposed an integrated P⁶ model for customer decision making in web services. This model consists of the newly introduced 6 Ps: privacy, preference, propensity, perception, personalization and promised experience and the existing 6 Ps: price, people, place, process, product and promotion. This chapter also examined case-based decision making in web services and provided a theoretical foundation for case based decision making in the condition of one problem with multiple solutions in web services. The

proposed approach will facilitate research and development of e-business, web services and decision support systems.

Besides mentioned in the future research directions, in future work, we will integrate the aforementioned new 6 Ps into a process and look at the strategies for each of these 6 Ps in a context of a strategic framework for CDM in web services. We will also apply the proposed model to a few real-world cases and test its efficiency and explore its value added to CDM in web services. We will develop this model into a framework. Finally, we will develop a system prototype based on the proposed theoretical approach to CBDM.

REFERENCES

- Awad, E. M. (2007). *Electronic commerce: From vision to fulfillment*. New Jersey: Prentice Hall.
- Becerra-Fernandez, I., Gonzalez, A., & Sabherwal, R. (2004). *Knowledge management: Challenges, solutions and technologies*. Upper Saddle River, NJ: Prentice-Hall.
- Bellazzi, R., Montani, S., & Portinale, L. (1999). *Integrating rule-based and case-based decision making in diabetic patient management. ICCBR-99, LNCS 1650* (pp. 386–400). Berlin, Germany: Springer.
- Booms, B., & Bitner, M. (1981). Marketing strategies and organization structure for service firms. In Donnelly, J., & Geoge, W. (Eds.), *Marketing of services*. New York, NY: American Marketing Association.
- Brohman, M. K., Watson, R. T., Piccoli, G., & Parasuraman, A. (2003). Data completeness: A key to effective net-based customer service systems. *Communications of the ACM*, 46(6), 47–51. doi:10.1145/777313.777339
- Chaffey, D. (2009). *E-business and e-commerce management* (4th ed.). London, UK: Prentice Hall.
- Chaffey, D., & Wood, S. (2005). *Business information management: Improving performance using Information Systems*. London, UK: Prentice Hall.
- Dearlove, D. (1998). *Key management decisions: Tools and techniques of the executive decision-maker*. London, UK: Pitman Publishing.
- Denning, P. J., & Hayes-Roth, R. (2006). Decision making in very large networks. *Communications of the ACM*, 49(11), 19–23. doi:10.1145/1167838.1167852
- (2007). *English Dictionary for Advanced Learners*. Macmillan.
- Fan, H., & Poole, M. (2003). *Perspectives on personalization* (pp. 2123–2130). AMCIS Proceedings.
- Gao, S., Wang, H., Xu, D., & Wang, Y. (2007). An intelligent agent-assisted decision support system for family financial planning. *Decision Support Systems*, 44, 60–78. doi:10.1016/j.dss.2007.03.001
- Giannoulis, C., & Ishizaka, A. (2010). A Web-based decision support system with ELECTRE III for a personalised ranking of British universities. *Decision Support Systems*, 48(3), 488–497. doi:10.1016/j.dss.2009.06.008
- Gilboa, I., & Schmeidler, D. (1995). Case based decision theory. *The Quarterly Journal of Economics*, 110(3), 605–639. doi:10.2307/2946694
- Gilles, R., James, T., & Barkhi, R. (2009). Simulating social network formation: A case-based decision theoretic model. *International Journal of Virtual Communities and Social Networking*, 1(4), 1–20. doi:10.4018/jvcsn.2009092201
- Goel, L., & Prokopec, S. (2009). If you build it will they come? – An empirical investigation of consumer perceptions and strategy in virtual worlds. *Electronic Commerce Research*, 9, 115–134. doi:10.1007/s10660-009-9031-7

- Gray, C. F., & Larson, E. W. (2008). *Project management-The managerial process* (4th ed.). New York, NY: McGraw Hill.
- Guerdjikova, A. (2004). *Will case-based decision makers survive in a financial market?* Retrieved from <http://www.socialpolitik.org/tagungshps/2004/Papers/Guerdjikova.pdf>
- Guruge, A. (2004). *Web services: Theory and practice*. Amsterdam, The Netherlands: Elsevier Inc.
- Helander, M. G., & Khalid, H. M. (2000). Modeling the customer in electronic commerce. *Applied Ergonomics/Elsevier*, 31 (6), 609-619.
- Huellermeier, E. (1999). A possibilistic formalization of case-based reasoning and decision making. In Reusch, B. (Ed.), *Computational Intelligence: Theory and Applications, LNCS 1625* (pp. 411-420). Berlin, Germany: Springer. doi:10.1007/3-540-48774-3_47
- Huellermeier, E. (2002). *Exploiting similarity and experience in decision making. FUZZ-IEEE '02*. IEEE CS.
- Huellermeier, E. (2007). *Case based approximate reasoning*. Dordrecht, The Netherlands: Springer.
- Kolodner, J. L. (1991). Improving human decision making through case-based decision aiding. *AI Magazine*, 12(2), 52-68.
- Kwon, O. B. (2003). Meta Web service: Building Web-based open decision support system based on Web services. *Expert Systems with Applications*, 24, 375-389. doi:10.1016/S0957-4174(02)00187-2
- Ladner, R. E. (2008). Soft computing techniques for Web service brokering. *Soft Computing*, 12, 1089-1098. doi:10.1007/s00500-008-0277-0
- Lautenborn, R. (1990, October 1). New marketing litancy: 4Ps passes, 4Cs takeovers. *Advertising Age*, 26.
- Legna, C. A., & González, S. C. (2006). Using system dynamics and case-based reasoning (CBR) to build an intelligent decision-making support system (i-DMSS) that improves strategic public decisions. In Jatinder, G. A., & Gupta, N. D. (Eds.), *Intelligent decision-making support systems: Foundations, applications and challenges*. Decision Engineering. doi:10.1007/1-84628-231-4_14
- Liu, C., Marchewka, J. T., Lu, J., & Yud, C.-S. (2005). Beyond concern—A privacy-trust-behavioral intention model of electronic commerce. *Information & Management*, 42(2), 289-304. doi:10.1016/j.im.2004.01.003
- McCarthy, J. (1960). *Basic marketing: A managerial approach*. Homewood, IL: Irwin.
- Myers, I. B. (1962). *Introduction to type: A description of the theory and application of the Meyers-Briggs type indicator*. Palo Alto, CA: Consulting Psychologists Press.
- Nilsson, N. J. (1998). *Artificial intelligence. A new synthesis*. San Francisco, CA: Morgan Kaufmann Publishers Inc.
- O'keefe, R. M., & McEachern, T. (1998). Web-based customer decision support systems. *Communications of the ACM*, 41(3), 71-78. doi:10.1145/272287.272300
- Papazoglou, M. P. (2008). *Web services: Principles and technology*. Harlow, UK: Prentice Hall.
- Rob, P., & Coronel, C. (1997). *Database systems: Design, Implementation, and management*. Cambridge, MA: Course Technology.
- Simon, H. A. (1977). *The new science of management decision*. Englewood Cliffs, NJ: Prentice Hall.
- Singh, M. P., & Huhns, M. N. (2005). *Service oriented computing: Semantics, processes, and agents*. Chichester, UK: John Wiley & Sons, Ltd.

Sun, Z., & Finnie, G. (2004). *Intelligent techniques in e-commerce: A case based reasoning perspective*. Berlin, Germany: Springer-Verlag.

Sun, Z., Finnie, G., & Yearwood, J. (2010). Case based Web services. In Lee, I. (Ed.), *Encyclopedia of e-business development and management in the global economy* (pp. 871–881). Hershey, PA: IGI. doi:10.4018/978-1-61520-611-7.ch087

Sun, Z., & Lau, S. K. (2007). Customer experience management in e-services. In Lu, J., Ruan, D., & Zhang, G. (Eds.), *E-service intelligence: Methodologies, technologies and applications* (pp. 365–388). Berlin, Germany: Springer.

Sun, Z., Meredith, G., & Jia, L. (2009). C6: A holistic model for decision making in Web services. In AAIS (Ed.), *20th Australasian Conference on Information Systems (ACIS2009)*, (pp. 904–914). Melbourne.

Sun, Z., Sun, J., & Meredith, G. (2010). Customer decision making in Web services with an integrated P6 model. *International Conference on Services Science, Management and Engineering (SSME 2010)*, 1, (pp. 340–343). Tianjin, China: IEEE Press.

Sun, Z., Wang, M., & Dong, D. (2010). Decision making in multiagent Web services based on soft computing. In Casillas, J., & Martínez-López, F. J. (Eds.), *Marketing intelligent systems using soft computing: Managerial and research applications* (pp. 389–415). Berlin, Germany: Springer Verlag. doi:10.1007/978-3-642-15606-9_22

Turban, E., & Volonino, L. (2010). *Information Technology for management: Improving performance in the digital economy* (7th ed.). Hoboken, NJ: Wiley & Sons.

Wang, H., Zhang, Y. Q., & Sunderraman, R. (2006). Extensible soft Semantic Web services agent. *Soft Computing*, 10, 1021–1029. doi:10.1007/s00500-005-0029-3

Yao, Y., Yang, F., & Su, S. (2006). Flexible decision making in Web services negotiation. In J. E. (Eds.), *AIMSA 2006, LNAI 4183* (pp. 108–117).

Zhang, L. J., Zhang, J., & Cai, H. (2007). *Services computing*. Berlin, Germany: Springer.

ADDITIONAL READING

Bell, M. (2008). *Service-oriented modeling (SOA): Service analysis, design, and architecture*. Chichester, UK: John Wiley and Sons Ltd.

Chen, L., & Tao, F. (2008). An intelligent recommender system for Web resource discovery and selection. In D. Ruan, D., F. Hardeman, & K. van der Meer (Eds.), *Intelligent decision and policy making support systems*, (pp. 113–140). Berlin, Germany: Springer.

Cheng, M.-Y., Tsai, H.-C., & Chiu, Y.-H. (2009). Fuzzy case-based reasoning for coping with construction disputes. *Expert Systems with Applications*, 36(2), 4106–4113. doi:10.1016/j.eswa.2008.03.025

Cheng, R., & Su, S. Yang, F., & Li, Y. (2006). Using case-based reasoning to support web service composition. In V. N. Alexandrov, et al. (Eds.), *ICCS 2006, Part IV, LNCS 3994*, (pp. 87 – 94). Berlin, Germany: Springer-Verlag.

Chung, J. Y., Lin, K. J., & Mathieu, R. G. (2003). Web services computing: Advancing software interoperability. *Computer*, 36(10), 35–37. doi:10.1109/MC.2003.1236469

Giannoulis, C., & Ishizaka, A. (2010). A Web-based decision support system with ELECTRE III for a personalised ranking of British universities. *Decision Support Systems*, 48(3), 488–497. doi:10.1016/j.dss.2009.06.008

- Gupta, J. N. D., Forgionne, G. A., & Mora, M. (Eds.). (2006). *Intelligent decision making support systems: Foundations, applications and challenges*. London, UK: Springer.
- Hammond, K. J. (1989). *Case-based planning: Viewing planning as a memory task*. San Diego, CA: Academic Press Professional, Inc.
- Han, W., Shi, X., & Chen, R. (2008). Process-context aware matchmaking for Web service composition. *Journal of Network and Computer Applications*, 31(4), 559–576. doi:10.1016/j.jnca.2007.11.008
- Hunink, M., & Glasziou, P. P. (2001). *Decision making in health and medicine*. Cambridge, UK: Cambridge University Press.
- Jeong, B., Cho, H., & Lee, C. (2009). On the functional quality of service (FQoS) to discover and compose interoperable Web services. *Expert Systems with Applications*, 36(3), 5411–5418. doi:10.1016/j.eswa.2008.06.087
- Lau, R. Y. K. (2007). Towards a Web services and intelligent agents-based negotiation system for B2BeCommerce. *Electronic Commerce Research and Applications*, 6(3), 260–273. doi:10.1016/j.elerap.2006.06.007
- Lawler, J. P. (2007). *Service-oriented architecture: SOA strategy, methodology, and technology*. Hoboken, NJ: Taylor & Francis Ltd. doi:10.1201/9781420045017
- Lu, J., Ruan, D., & Zhang, G. (Eds.). (2006). *E-service intelligence*. Berlin, Germany: Springer Verlag.
- Madhusudan, T., & Uttamsingh, N. (2006). A declarative approach to composing Web services in dynamic environments. *Journal of Decision Support Systems*, 41(2), 325–357. doi:10.1016/j.dss.2004.07.003
- Park, C.-S., & Park, S. (2008). Efficient execution of composite Web services exchanging intensional data. *Journal of Information Science*, 178(2), 317–339. doi:10.1016/j.ins.2007.08.021
- Psaila, G., & Wagner, R. R. (Eds.). (2008). *E-commerce and Web technologies. Proceedings 9th International Conference, EC-Web 2008, (LNCS)*, Turin, Italy, September 3–4, 2008. Berlin, Germany: Springer Verlag.
- Ranyard, R. (2005). Decision making strategies. In Everitt, B. S., & Howell, D. C. (Eds.), *Encyclopedia of statistics in behavioral science*. Wiley. doi:10.1002/0470013192.bsa652
- Sahai, A., & Graupner, S. (2005). *Web services in the enterprise: Concepts, standards, solutions, and management (network and systems management)*. New York, NY: Springer.
- Sun, Z., Dong, D., & Yearwood, J. (2011). Demand driven Web services. In Leung, H., Chiu, D. K. W., & Hung, P. C. K. (Eds.), *Service intelligence and service science: Evolutionary technologies and challenges* (pp. 35–55). Hershey, PA: IGI Global.
- Talukder, A. K., & Yavagal, R. R. (2007). *Mobile computing: Technology, applications and service creation*. New York, NY: McGraw-Hill Inc.
- Tatemura, J., & Hsiung, W. P. (2006). Web service decomposition: Edge computing architecture for cache-friendly e-commerce applications. *Electronic Commerce Research and Applications*, 5(1), 57–65. doi:10.1016/j.elerap.2005.08.001
- Ting, I.-H., & Wu, H. J. (Eds.). (2009). *Web mining applications in e-commerce and e-services*. Berlin, Germany: Springer Verlag. doi:10.1007/978-3-540-88081-3
- Wooldridge, M. (2002). *An introduction to multiagent systems*. Chichester, UK: John Wiley & Sons Ltd.

Zhang, L. J., Zhang, J., & Cai, H. (2007). *Services computing*. Beijing, China: Tsinghua University Press.

Zhao, J. L., & Cheng, H. K. (2005). Web services and process management: A union of convenience or a new area of research? *Journal of Decision Support Systems*, 40(1), 1–8. doi:10.1016/j.dss.2004.04.002

Zimmermann, H. (2001). *Fuzzy set theory and its applications*. Boston, MA: Kluwer. doi:10.1007/978-94-010-0646-0

KEY TERMS AND DEFINITIONS

Case Based Decision Making (CBDM): Any decision making using a strategy based on case based reasoning such as “similar problems have similar solutions”.

Case-Based Reasoning (CBR): CBR is a reasoning paradigm based on previous experiences or cases; that is, a CBR system solves new problems by adopting solutions that were used to successfully solve old problems. Therefore, CBR is a kind of experience based reasoning. Experience based reasoning is a more general computing paradigm than CBR. Case-based intelligence, case-based management, case-based engineering and case-based computing are future directions for CBR research and development.

Decision Making: A selection of choices or alternatives for solving a problem or reaching a goal. Decision is at the centre of any decision making.

Decision Making Lifecycle (DMCL): A decision making process that starts with a planning

step from decision makers, follows by steps of selecting an optimal solution or action for a given problem from available choices, and ends with the selected action to solve the given problem.

Intelligent System: An intelligent system is a system that can imitate, automate some intelligent behaviors of human being. Expert systems, intelligent agents and knowledge-based systems are examples of intelligent systems. Currently, intelligent systems is a discipline that studies intelligent behaviors and their implementations as well as their impacts on human society.

Service Computing: Service computing is a research field about service intelligence, service science, service technology, service engineering, service management, service systems, and service application. It is the most general representation form of studying service in computing discipline.

Web Services: General speaking, web services are all the services available on the Web or the Internet from a business perspective. The first web services were information sources (Schneider, 2003). From a technological perspective, web services are Internet-based application components published using standard interface description languages and universally available via uniform communication protocols. Web services is an important application field of service intelligence and service computing.

Web Service Lifecycle (WSLC): It consists of the start of a web service, the end of web service and its evolutionary stages that transform the web service from the start to the end. Many activities are included in a WSLC such as web service discovery, composition, recommendation and management.