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# Leveraging Market Research Techniques in IS – A Review of Conjoint Analysis in IS Research

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# Leveraging Market Research Techniques in IS – A Review of Conjoint Analysis in IS Research

*Completed Research Paper*

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## Abstract

*With the increasing importance of mass-market information systems (IS), understanding individual user preferences for IS design and adoption is essential. However, this has been a challenging task due to the complexity of balancing functional, non-functional, and economic requirements. Conjoint analysis (CA), from marketing research, estimates user preferences by measuring tradeoffs between products attributes. Although the number of studies applying CA in IS has increased in the past years, we still lack fundamental discussion on its use in our discipline. We review the existing CA studies in IS with regard to the application areas and methodological choices along the CA procedure. Based on this review, we develop a reference framework for application areas in IS that serves as foundation for future studies. We argue that CA can be leveraged in requirements management, business model design, and systems evaluation. As future research opportunities, we see domain-specific adaptations e.g., user preference models.*

**Keywords:** Information systems, design, evaluation, conjoint analysis, user preferences

## 1 Introduction

Understanding user requirements and the factors that drive user adoption are crucial when designing information systems (IS). However, the user perspective is far from easy to grasp, owing to the complexity of IS solutions and the many tradeoffs between different properties and multiple functional, non-functional, and economic dimensions. In fact, the IS domain has experienced a shift from customer-specific systems in enterprises to a “market in which vendors package ready-to-install products” (Sawyer 2001, p. 97). As a result of technology advances, such as mobile and cloud computing, today’s systems can be described as mass-market IS, which target distributed and heterogeneous end-users. For software vendors, these types of commercial systems create challenges, since they require different bundling and pricing strategies with segmentation of users to fulfill the needs of multiple user profiles. Thus, there is a need to tailor existing development methods to address the specificities of mass-market IS (Fitzgerald et al. 2003; Karlsson and Agerfalk 2004).

Traditionally, user-oriented design of IS was promoted through requirements elicitation. Elicitation techniques collect data from individual or group users via interviews, surveys, focus groups, ethnographic techniques comprising user contextual observations, cognitive techniques, and/or prototyping (Nuseibeh and Easterbrook 2000). Since most of them rely on close interactions with users or their representatives, they are difficult to apply in the context of mass-market IS with individual and dispersed users. Moreover, these techniques critically depend on participant selection, which can bias requirements representation. Thus, the need to integrate the *customer’s voice* calls for new approaches in IS design to ensure the widest

customer reach and acceptance (Jarke et al. 2011; Tuunanen et al. 2010) and to capture different user perceptions for well-defined product and service bundles.

Market research techniques, specifically conjoint analysis (CA), are promising approaches to address these goals and to support the user-oriented design of IS. We argue that CA could have a significant impact on IS research (and practice) if it were fully developed and adopted as a methodology in IS. CA has become the most applied market research technique in the past decades and is increasingly used in IS studies. It is “a practical set of methods for predicting consumer preferences for multi-attribute options in a wide variety of product and service contexts” (Green and Srinivasan 1978, p. 103). CA’s popularity is due to its allowing for the measuring of user tradeoffs when evaluating products or services, adding a quantitative measurement that reflects optimal product or service design, which better fit users’ needs. Marketing research has argued that the conjoint method is particularly useful in new technical product development (Green et al. 2001; van Kleef et al. 2005). In the IS domain, the CA methodology was first suggested by Bajaj (1999), who emphasizes its usefulness for studying human behavior in the assessment of IS for purchase decisions and adoption. In this context, conjoint methodology could extend the Technology Acceptance Model (TAM) to study other acceptance variables than perceived usefulness (PU) and perceived ease-of-use (PEOU), such as product attributes and external factors. IS researchers started employing CA to study adoption decisions as well as users’ preference structures governing IS design based on Bajaj’s (1999) CA study procedure guide. Examples of studies applying CA are those by Schaupp and Bélanger (2005) on purchase decisions in e-commerce, Keil and Tiwana (2006) on ERP package evaluation, Bouwman et al. (2008) on the design preferences and adoption of mobile applications for police officers, and Giessmann and Stanoevska (2012) on cloud services. While these studies demonstrate CA’s value in the IS domain, they have mostly been one-time efforts, and we still lack a fundamental discussion on its uses in IS. This motivates our research.

We seek to lay the foundation for future studies by analyzing the current state of conjoint method application in the IS domain via a systematic literature review. For this purpose, we provide a comprehensive analysis of the 46 CA studies published between 1999 and 2016 in the IS field. Our contribution is three-fold: First, we critically assess the existing CA studies in IS with regard to the application areas and methodological choices along the CA procedure. Second, based on our review, we develop a reference framework for applying CA as a methodology for IS that may serve as a foundation for future studies. Third, we outline opportunities for future research and the further development of CA in the IS domain.

The remainder of this paper is structured as follows: In Section 2, we review the current state of conjoint analysis and its evolution over time as well as application areas. In Section 3, we present our research methodology, based on Webster and Watson’s (2002) guidelines for literature reviews. In Section 4, we summarize the findings of the literature review along the analysis framework. In Section 5, we discuss implications of this research and make recommendations for the domain-specific adaptation of CA. We conclude with a summary of our findings and limitations as well as future research opportunities.

## **2 Prior Research: Conjoint Analysis**

### **2.1 Foundations of Conjoint Analysis**

Conjoint analysis has its foundations in the work of Green and Rao (1971), who advocated the use of conjoint measurement in consumer-oriented marketing research. As a concept from mathematical psychology established by Luce and Tukey in 1964, conjoint measurement is used to measure “the joint effects of a set of independent variables on the ordering of a dependent variable” (Green and Rao 1971, p. 355). Accordingly, it is well suited to problems in marketing as an approach to quantify judgmental data.

The original approach, also called *concept evaluation* or *full-profile*, is based on rank orders of consumers’ preferences of product profiles (also called stimuli) composed of several attributes and levels that refer to product characteristics. Thus, part-worth utilities of each attribute are determined by applying an additive composition rule. Besides the *concept evaluation*, Johnson (1974) suggested an alternative approach called the *tradeoff matrix* or *pairwise approach*, in which respondents evaluate a pair of attributes, providing information about the tradeoffs among all product features. This method’s

strength is its ability to support a large number of attributes, since it can make predictions based on the evaluation of subsets of attribute pairs (Johnson 1974).

A traditional conjoint study would rely on six steps, as suggested by Green and Srinivasan (1978); we highlight the key aspects:

1. **Preference model selection:** As a de-compositional method that allows for the exploration of consumers' tradeoffs, the part-worth utility function is the most attractive model, owing to its flexibility in presenting attributes preferences.
2. **Data collection method:** This involves selecting a conjoint method approach. The full-profile approach is most frequently used, since it provides a more realistic description of the stimuli. However, as mentioned, the pairwise approach has an advantage when the attribute number is large.
3. **Stimulus set construction:** Depending on the number of attributes in a conjoint study, the number of stimuli could be very high, which burdens the participants. Thus, researchers tend to reduce the number of stimuli to facilitate participants' evaluation task. This is mainly based on fractional factorial orthogonal design, assuming no interaction effects among the selected attributes.
4. **Stimulus presentation:** Several variations exist, such as verbal description, paragraph description, or pictorial representation. The choice of the presentation depends on the product type and can be a combination of methods. Further, when applying CA in some product categories, such as packaged goods, prototypes, or actual products could be used to provide more realistic stimuli.
5. **Measurement scale:** Scales depend on the study purpose and on the data collection method. While both methods (the full-profile and the pairwise approach) can use ranking to capture preferences or purchasing intentions, the full-profile approach could also use ratings of the different presented profiles.
6. **Estimation method:** It is selected based on the dependent variable type resulting from the measurement scale. While an ordinal-scaled variable could use MONANOVA, an interval-scaled variable can for instance use an ordinary least squares (OLS) regression. In addition, LOGIT or PROBIT models can be used when a choice-probability model is applied for data.

To illustrate the CA procedure, take the simplified example of a smartphone. In Table 1, we introduce attributes and attribute levels of the product class selected based on existing product specifications in the market. For the conjoint method, we selected a part-worth function model (Step 1) in a full-profile approach (Step 2). The stimulus set of three attributes with three levels would lead to 27 ( $=3^3$ ) product concepts. Fractional-factorial design (Step 3) would be employed to arrive at a reduced design, in this case with nine stimuli. In our smartphone example, the stimulus presentation (Step 4) can benefit from a combination of verbal description and pictorial representation (or the de facto prototype, if available) to help participants see the differences between screen sizes. This would enable them to rank (Step 5) the stimuli based on their preferences. Multiple regression analysis could be employed to estimate the part-worth utilities (Step 6). The utilities are then calculated by adding individuals' part-worth utilities, i.e., following the use function  $u = \sum_{i=1}^k u_i + e$ . Finally, the part-worth utilities are standardized, to ensure that all utilities use the same unit of scale.

<i>Attributes</i>	<i>Attribute levels</i>		
<b>Price</b>	\$200	\$400	\$700
<b>Screen size</b>	4.7 inches	5.2 inches	6 inches
<b>Camera resolution</b>	8 MP	12 MP	20 MP

**Table 1. Example for Attributes and Attribute Levels of a Conjoint Analysis**

## 2.2 Developments and Extensions of the CA Method

Owing to the prevalence of CA, the methods for applying it have been further developed and improved (see Table 2). During the 1980s, two additional CA approaches were introduced to address the data collection step in terms of evaluation methods: adaptive conjoint analysis (ACA), and choice-based conjoint analysis (CBCA) (Green et al. 2001). Adaptive conjoint analysis, which was developed by

Sawtooth Software to solve the number of attributes issue faced in the traditional full-profile CA, is based on a hybrid technique that combines self-explicated tasks with an evaluation of partial-profile descriptions (Green 1984; Johnson 1987). The self-explicated task allows respondents to rate attributes individually and to exclude unacceptable attribute levels from the evaluation task (Johnson 1987).

Choice-based conjoint analysis can be considered as a replacement of ranking-based or rating-based conjoint methods. It simulates the process of purchasing a product; participants are asked to make hypothetical choices in a scenario similar to a competitive marketplace, and their individual-level utility function is estimated using Hierarchical Bayes (HB) (Johnson et al. 2003). The main concern with this approach is that participants need to evaluate a large number of purchase scenarios; however, it has the advantage of being able to deal with the complexity of choosing among competitive profiles, which makes it a mixed blessing (Green et al. 2001).

As a combination of the two approaches, adaptive choice-based conjoint analysis (ACBCA) is able to estimate part-worth utilities from a small sample size with less than 100 participants (Johnson et al. 2003). ACBCA asks participants to choose among a set of stimuli to select the most relevant attributes and levels, simulating purchase behaviors similar to the CBCA after participants perform a self-explicated task (which is performed in an ACA).

Further developments to the presented CA methods have been discussed by several researchers (Netzer et al. 2008; Rao 2008); they mainly targeted technique and application issues. Given the variety of approaches, the decision on the CA method becomes more complex, but would be based on several criteria, including product and study-related factors. Orme (2009) has thoroughly discussed this matter by demonstrating advantages and limitations of each CA type and then building a recommendation guide for selecting the appropriate method. He proposes the following main selection criteria: the number of attributes, the mode of interviewing, the sample size, the interview time, and the inclusion of pricing research in a study. Generally, adaptive methods are more favored when the number of attributes is large or the sample size is small. Choice-based methods are preferred for pricing studies.

CA steps	Alternative methods to CA	
	Traditional conjoint analysis (proposed by Green and Srinivasan 1978)	Developments and extensions
1. Selection of the preferred model	Vector model, ideal-point model, part-worth function model, mixed	
2. Data collection method	Two-factor-at-a-time (tradeoff analysis), full-profile (concept evaluation)	ACA, CBCA, adaptive CBCA
3. Stimulus set construction	Fractional factorial design, random sampling from multimethod variate distribution	Partial profiles, self-explicated method
4. Stimulus presentation	Verbal description (multiple cue, stimulus card), paragraph description, pictorial or three-dimensional model representation	Actual products, prototypes
5. Measurement scale	Paired comparisons, rank order, rating scales, constant-sum paired comparisons, category assignment	
6. Estimation method	MONANOVA, PREFMAP, LINMAP, Johnson’s non-metric tradeoff algorithm, multiple regression, LOGIT, PROBIT	Hierarchical Bayes

Table 2. CA Steps Based on Green and Srinivasan (1978)

### 2.3 Applications in Marketing Research

After the introduction of conjoint methodology by Green and Rao (1971), its application became widely popular in consumer research and was extended into applied psychology, decision theory, and economics (Green and Srinivasan 1978). CA is used to measure consumer tradeoffs between product attributes and to derive user preferences or intentions to buy. It is “marketers’ favorite methodology for finding out how buyers make tradeoffs among competing products and suppliers” (Green et al. 2001, p. S56).

Previous research has exposed the different application areas for CA in marketing based on different techniques. Green and Rao (1971) have paved the way for different suggestions: 1) **vendor evaluation** by developing criteria for vendor rating, 2) **price-value relationship** by measuring consumer tradeoffs for price and quality of products, 3) **attitude measurement** to analyze the tradeoffs between several

product attributes and to derive the importance of functional vs. symbolic characteristics such as brand image, or to analyze utility for collections of items to facilitate combination packaging of certain product types, 4) **cost-benefit analysis** to study the willingness-to-pay (WTP) for certain attributes and to design products accordingly, and 5) **clustering or segmentation of customers** based on their utility functions. Further, Johnson (1974) has referred to another application using **market simulation**, which is used to estimate market shares of currently available or new products based on predicted consumer preferences of the study sample.

In the practical domain, there were two comprehensive surveys on the commercial use of CA in the 1980s to explore applications of this method in marketing research. The first (Cattin and Wittink 1982) showed that the method is mainly applied for concept or product design, whether a development of a new product or a modification of an existing one based on feature (attribute) preferences. Pricing was also among the most important objectives for using this approach. Other domains for application have also been presented, such as market segmentation, advertising, and distribution. In an update to this survey (Wittink and Cattin 1989), competitive analysis was ranked among the top objectives for using CA in marketing research via the application of a market simulation, with the help of computer software (e.g., Sawtooth Software).

Marketing research has proved that conjoint methodology is a useful tool in providing insights into consumer preferences and predicting consumer behaviors in purchasing decisions and intentions to buy. Beyond marketing, the strategy literature has adopted CA as a decision support tool, for instance to evaluate decision policies by top managers (Priem 1992). Green et al. (2001) have also foreseen the future of the CA method in other application domains, extending other fields such as telecommunications and banking services, also extending consumer bases to involve stakeholder groups, suppliers, and employees.

### **3 Research Methodology**

The objective of this research is to summarize the current state of conjoint studies in IS and to provide a critical assessment concerning its domain-specific applications and methodological aspects. We explore the different domains in IS in which CA has been applied, and propose application areas, following Bajaj's (1999) suggestion. We develop a framework that IS researchers can use to guide their research, employing CA as their methodology. We follow the recommendations of Webster and Watson (2002) on conducting a literature review in the IS field.

#### **3.1 Literature Selection**

Seeking to attain completeness and quality in our review, we conducted a comprehensive longitudinal analysis of peer-reviewed publications, starting from Bajaj (1999) until the end of 2016. To identify empirical studies using CA in top IS journals, we relied on the *Senior scholars' basket of journals* from the Association of Information Systems (AIS) including the *European Journal of Information Systems*, *Information Systems Journal*, *Information Systems Research*, *Journal of AIS*, *Journal of Information Technology*, *Journal of MIS*, *Journal of Strategic Information Systems*, and *MIS Quarterly*. We then performed an electronic search in the following databases: AIS Electronic Library (AISE), EBSCOHost, ScienceDirect, Springerlink, and Wiley. This was followed by a Google Scholar search to cover any missing studies. To ensure that we capture all relevant pieces of research, the search criteria was based on the following keywords: *conjoint analysis* OR *consumer preferences*; we used filtering where possible to restrict the search to the title or abstract. In addition, in advanced search, we restricted the research area to IS/IT and business management when the search resulted in many irrelevant articles. We performed backward and forward citation searches to identify prior articles as well as relevant articles that could have been missed by the search criteria (Webster and Watson 2002).

The literature selection phase resulted in 66 publications in proceedings of highly reputable international and regional IS conferences as well as publications from academic journals relating to IS/IT and business research. We then scanned these by carefully reading the abstract to judge their relevance; we eliminated 15 publications, which are not in relevant domains or lack methodological illustrations. The procedure resulted in 52 relevant studies in 51 publications – Bouwman et al. (2008) had two CA studies in the same

publication. The final sample comprises 46 studies, since we combined six studies in conference papers with their extended versions published as journal articles.

### 3.2 Literature Analysis & Classification

Building on the suggestion by Webster and Watson (2002), we developed an analysis framework to synthesize the literature and to provide a guide for future CA studies. We were able to analyze and group the CA studies and the different applications based on a coding scheme that reflects CA techniques and procedures. The resulting coding scheme covers three elements: attribute and level selection, data analysis building on relevant aspects of Green and Srinivasan's (1978) CA steps, and study administration. We also included coding of the **publication type** (i.e., conference or journal publications), the specific **category of IS** investigated using CA, and the **study purpose** to help classify the literature.

### 3.3 Attribute & Level Selection Coding

The first step in a CA study involves representing the system class with a set of attributes and levels. The coding then involves: **attributes selection** (literature review, focus groups, user interviews, questionnaires, expert interviews, or existing products), **number of attributes**, and **attribute level type** (binary, multileveled, or multicriteria).

### 3.4 Data Analysis Coding

A coding of CA steps is useful to analyze the literature and how the method is used in the IS domain compared to other fields. Based on the CA steps suggested by Green and Srinivasan (1978) (see Table 2), the coding involved: the **preference model**, the **data collection method**, the **stimuli design and type of stimuli** to account for the stimulus set construction and presentation, the **measurement scale** of the dependent variable in the CA, and the **estimation method**.

After the estimation of the utility functions, further techniques in CA can be applied for certain study scenarios. The coding captures **analysis techniques** that are frequently performed beyond the relative importance of attributes. These techniques (see Section 2.3) comprise market segmentation (including clustering methods), WTP (based on a defined price attribute), and market simulation (to provide a competitive analysis).

### 3.5 Study Administration Coding

In terms of **study setup**, CA surveys can be conducted via face-to-face interviews, experiments, questionnaires, or online surveys. The second code relates to the use of specific software to perform the study. This coding of **software used** can help provide suggestions for the designs of future studies. Also, as the CA method targets heterogeneous and distributed users, researchers must decide the representative **sample size** for their study, and most importantly, the targeted user base (i.e., **subjects' backgrounds**).

## 4 CA Studies in IS Research

### 4.1 Overview

Based on our systematic literature review, we identified 52 studies from IS research in which CA is applied as a methodology. Table 5 (see Appendix) presents an overview of 26 studies in journal articles and 26 conference proceedings, including bibliographic and meta-information on each article (year, study objective as described in the paper, purpose, domain, CA method type, study sample size, and subjects' backgrounds). The statistics in Table 3 and the following sections refer to the total number of conjoint studies (i.e., 46) that combine the conference proceedings that were further developed into journal articles with the latter (highlighted in Table 5).

Coding item	Coding options	Number of studies	Percentage (%)
IS category	Enterprise systems	8	17.4
	Mobile applications & communication	16	34.8
	E-commerce	6	13
	Online services	9	19.6
	Cloud services	5	10.9
	Internet of Things	2	4.3
Study purpose	Decision-making	6	13
	Adoption	13	28.3
	IS design	12	26.1
	Pricing	9	19.6
	Information privacy	5	10.9
	Channel selection	2	4.3
Attributes selection	Literature review	35	76.1
	Existing products	13	28.3
	Expert interviews	11	23.9
	Questionnaires	4	8.7
	User interviews	7	15.2
	Focus groups	6	13
Method type	TCA	28	60.9
	ACA	6	13
	CBCA	11	23.9
	ACBCA	1	2.2
Analysis techniques	WTP	14	30.4
	Segmentation	21	45.7
	Simulation	6	13

**Table 3. Summary of Results from the Literature Review of CA Studies in IS**

Overall, we found more than 20 types of information systems and applications that were investigated via CA. We classified them into five main categories:

- **Enterprise systems (ES):** This category includes studies on computing architecture, office systems, and enterprise resource planning (ERP) systems.
- **Mobile applications and communications (MC):** Studies in this category mainly covered mobile platforms, mobile applications, and mobile communication infrastructure.
- **E-commerce (EC):** This category relates to online shopping applications.
- **Online (O) services:** Studies cover different type of online services, such as social networks and online banking.
- **Cloud (C) services:** This category relates to services provided on the cloud, such as data storage, Software as a Service (SaaS) and Platform as a Service (PaaS).
- **Internet-of-Things (IoT):** Studies covering connected and smart devices.

We were able to map the study objectives and results to the different applications in marketing research (see Section 2.3) and associate them with one or more CA techniques employed (i.e., relative importance, WTP, segmentation, and simulation). From this mapping, based on identified patterns from the literature coding, we derived six typical purposes for CA in IS:

- **Organizational decision-making (DM):** The purpose is mainly associated to situations involving managerial decisions on adopting information systems in an organizational context. This includes selecting decision criteria for systems evaluation based on the studies attributes' relative importances. These studies are similar to vendor evaluations in marketing research.
- **End-user adoption (A):** The purpose is to understand customer preferences or behaviors in adopting new technologies. While they are similar to decision-making studies, they target user intentions to use rather than the selection or evaluation of a system. This is based on preference predictions derived from utilities estimated from evaluations of product profiles. The study could also employ segmentation to analyze different user groups' preferences. Compared to marketing research, this is part of attitude measurement applications.



- **IS design (D):** The study purpose is to elicit user preferences for designing a new IS as a product, an application (in the context of mobile development), and services. This is based on measuring preferences and tradeoffs among attributes and levels related to systems requirements. This will then reflect the relative importance of each attribute and level from the estimated part-worth utilities to guide the product class' design process. These study types can also include techniques of WTP and user segmentation.
- **Pricing (P):** The purpose is to understand WTP for product or service features. These studies mainly involve cost-benefit analysis, based on an analysis of the price attribute variations' effects on the resulting user preferences and preferences predictions.
- **Information privacy (IP):** The study purpose is to measure tradeoffs between information privacy concerns and monetary values, which could be achieved through tradeoff analysis of information privacy attributes with monetary rewards or by applying WTP analysis for certain information privacy attribute levels.
- **Channel selection (C):** The study seeks to understand user preferences for different information distribution channels by evaluating different profiles and estimating the part-worth utility function, which reflects the selection decision.

## **4.2 Attribute & Level Selection**

Selecting attributes and levels is a key decision in CA study design. Most studies of CA rely on a literature review of a domain-specific topic to select attributes (Table 3). Also, evaluating existing product features is a common method used especially in studies of IS design. More than 50% of these studies followed a multistage selection process. The most common combinations are a literature review with an evaluation of existing products or with expert interviews to gain insights into feasible features. In some cases, a three-stage selection process was performed to get user insights via questionnaires, interviews (Choi et al. 2013), or focus groups (Brodt and Heitmann 2004; Giessmann and Stanoevska 2012; Nikou et al. 2014).

The number of attributes correlates to the selected conjoint method. Most studies followed the pattern suggested by Orme (2002) on attribute selection, where traditional full-profile studies considered up to six attributes; adaptive studies included more. However, there were exceptions, where full-profile CA contained more than six attributes. These cases depend on the study purpose and were mainly in decision-making CA where the attribute levels are limited to binary (low or high) (e.g., Benlian and Hess 2011; Keil and Tiwana 2006) or multilevel (low, medium or high) (e.g., Mahindra and Whitworth 2005) or in service design studies that involved bundling options with binary attributes corresponding to services (included or not included) (e.g., Daas et al. 2014).

## **4.3 Data Analysis**

All the studies were conducted after 2000, which means that the extended developments of conjoint methods already existed. They were all based on a part-worth utility preference model (as pointed out in Section 2.1). Interestingly, the conjoint studies in IS mainly used the traditional approach (60.9%) and did not consider the improvements presented in Section 2.2. Studies in the IS domain relied mostly on traditional full-profile CA, even though studies with a large number of attributes – according to CA guidelines – should better rely on adaptive methods. It must also be noted that none of the methodologies strictly related to the study purpose according to CA literature. For instance, CBCA was applied for pricing, adoption, decision-making, and service design studies, although it is said to mainly support pricing decisions. Also, there was only one application of ACBCA by Giessmann and Stanoevska (2012) for cloud service design. The dominance of the full-profile CA implies that CA studies in IS rely on hypothetical system representations rather than on realistic choices, and are more constrained concerning the number of attributes.

The stimulus set construction depends on the data collection method. Studies of traditional or choice-based CA employed fractional factorial design to reduce the number of stimuli for a large number of attributes or levels. When adaptive methods are used, the self-explicated method helps to reduce the attribute set, to facilitate the study procedure. Most studies employed verbal description in the form of profile cards, and paragraph description as vignettes and scenarios. Interestingly, few studies used visual representation in evaluating website features for online services (Hann et al. 2007; Mahindra and

Whitworth 2005), as well as e-commerce (Tamimi and Sebastianelli 2015). In adoption studies of existing products in IS (e.g., for enterprise systems), a de facto product would be of great significance to study participants. Even if it requires more resources for study setup, it should be used in categories such as online services, cloud services, e-commerce, and mobile applications to improve the quality of CA results.

The method for estimating the part-worth utilities of product attributes varies depending on the measurement scales. Ranking and rating were used similarly in the traditional approaches, and OLS is the main estimation method used. In the choice-based studies, a mix of the logit model was used to estimate utilities based on probabilistic assumptions from users' choices, and Hierarchical Bayes to obtain participants' individual utilities.

In addition to the relative importance of attributes based on the part-worth utilities, other data analysis techniques were applied in a CA study. **Market segmentation** is one technique applied by 20 studies to develop market segments based on groupings generated from sample demographics or specific clustering analysis techniques corresponding to the type of the conjoint method (the most commonly used are k-means clustering for full-profile or ACA, and hierarchical agglomerative clustering analysis for CBCA). **Willingness-to-pay** is another technique that was used mainly in the pricing, privacy tradeoff, and decision-making studies where a price attribute is included. Also, a different application of this technique was elaborated in the study by Baek et al. (2004), where the price was the dependent variable that was determined by the study participants for different online games options. Finally, **market simulation** can also be employed in the context of a competitive market analysis. It was employed by five studies in the current list, including Choi et al. (2013), Daas et al. (2014), Fritz et al. (2011), Song et al. (2009), and Weinreich and Schön (2013). Their main purpose was to predict market shares of new products or modified existing products based on preference models, and to evaluate the contribution margin. CA of PaaS by Giessmann and Stanoevska (2012) suggested the simulation method as a tool to design cloud business models.

#### **4.4 Study Administration**

Online surveys are the most frequently used research method for applying CA owing to their adaptability to a large sample size and high availability of online resources and survey software. CA could be performed using statistical tools such as R and SPSS with a conjoint package integrated to them, or through the use of specialized commercial software such as Sawtooth Software, the market leader, or Globalpark Software (e.g., Krasnova et al. 2009; Mann et al. 2008). The latter typically administer an online survey and are mainly used in studies that apply adaptive methods.

Marketing research deploys commercial panels to identify target samples whereas, in IS research, no existing panels are present for this methodology type. To date, very few studies have used existing online panels, such as Fritz et al. (2011). Although the sample in most conjoint studies comprises only consumers, the sample background in the IS literature depends on the study purpose. For instance, managers are considered as study samples in research involving organizational decision-making regarding IS/IT purchases or adoption. Other samples concerning users include student populations owing to the convenience of this sample in research. For instance, students performed a decision-making study taking roles as managers in an evaluation situation of corporate browsers (Mahindra and Whitworth 2005). Further, some researchers have applied CA in student-dedicated studies, such as mobile adoption (Head and Ziolkowski 2010) and cloud service adoption (Burda and Teuteberg 2015).

In marketing research, the typical sample size has a median of 300 especially in traditional CA. However, for adaptive methods, the sample size can be less than 100 and can still retain its statistical significance. In IS research, no specific patterns were identified. However, the median determined for the sample literature is 170. It is worth noting that the variance in our case is high owing to large-scale online studies with more than 1,000 respondents and several controlled studies with less than 30 respondents.

## **5 Synthesis and Discussion**

### **5.1 The Current State of CA in IS and Recommendations**

Our review reveals that there are a large variety of scenarios for using CA in IS, as well as a large number of CA variants from market research. While to date CA studies in IS have mostly used the basic

techniques, there are many more options for using CA in specific situations. Table 4 provides a synthesis of our findings for the different steps in the CA procedure. It summarizes the current state, as discussed in Section 4.2, and critically assesses it against the CA literature (Sections 5.2 and 5.3). For future CA studies, it provides recommendations (R) to leverage existing CA methods in IS and suggests domain-specific adaptations (A) to enhance methodological support for CA studies in IS. Most importantly, these adaptations should address key challenges in conducting conjoint analysis, mainly in the study preparation: (1) the **choice of the CA variant for specific study objectives**, and (2) the first step of the study procedure, i.e., **user preference modeling** with attribute and level selection. We elaborate on both aspects in Section 5.3.

<b>CA procedure</b>	<b>Current State</b>	<b>Recommendations (R) and domain-specific adaptations (A)</b>
Attributes and levels Selection	Most studies use mixed methods in a multistage process for attribute selection	<b>A:</b> Creation of domain-specific user preference models to support selection
Data collection method	Since traditional CA is dominant, the number of attributes is constrained	<b>R:</b> Use of ACA, CBCA, and ACBCA to deal with high attribute numbers
Stimulus set Construction and presentation	Verbal and paragraph descriptions are mostly used; only a few studies relied on pictorial representations for websites	<b>R:</b> Development of prototypes and actual products (or mock-ups) to simulate realistic choices
Data analysis	IS studies don't exploit the full set of CA techniques; they mostly analyze relative importance from estimated utilities	<b>A:</b> Methodological guidance in selecting the data analysis techniques and applying them in design (ex-ante) and evaluation (ex-post) phases
Sample selection	The sample depends on the study purpose (e.g., students or managers); the sample size largely varies, but is often too small	<b>R:</b> Establishment of IS-specific panels to increase sample sizes
Study administration	Online surveys are mostly employed, and the subsequent analysis is based on statistical packages or commercial software	<b>R:</b> Exploration of software and packages to combine online data collection and analysis

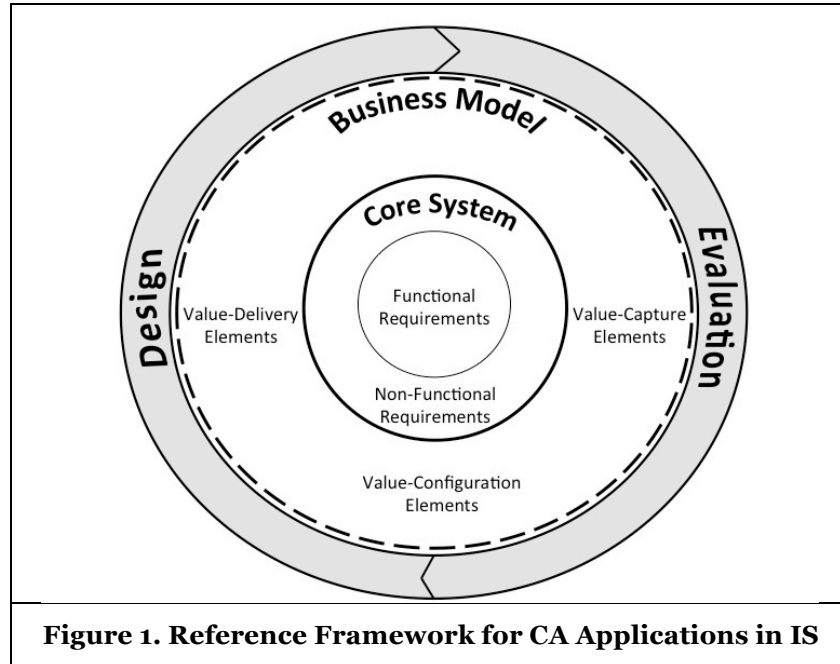
**Table 4. Current State of CA in IS and Guidelines**

## 5.2 A Framework for Using CA in IS

CA provides a number of very useful data analysis techniques, including the **estimation method** (part-worth utilities estimation for preferences), **market segmentation** or **clustering**, **WTP** (for a price attribute), and **market simulation** (to provide a competitive analysis context). These techniques can be used in manifold ways in the IS domain, but have not yet been fully leveraged. Based on our review and the identified purposes of CA studies, we suggest scenarios for applying CA in IS. We grouped them into a framework (Figure 1) that may guide future studies in IS. The framework outlines application areas where CA can have substantial impacts and significant potentials for design and evaluation in IS. The framework depicts that CA can be used in different phases – ex-ante in the design phase and ex-post in the evaluation of existing systems – and address different scopes. The narrowest scope is the core system, in which functional and non-functional requirements can be elicited and analyzed. In the case of online and cloud services, a broader scope is often applied, and business model elements can be evaluated via CA. Specifically, value delivery in terms of channel selection and customer relationships, value capture regarding value propositions and economic aspects (i.e., pricing) of the system linked to the customer segments, and value configuration elements specifically related to partnerships.

**IS design:** CA is a very well suited methodology for preference elicitation and can support IS design at different levels (e.g., Bouwman et al. 2008; Giessmann and Stanoevska 2012; Kim 2005; Nevo et al. 2012; Zubey et al. 2002). This is established by studying user design preferences for defined attributes relating to functional or non-functional characteristics leading to core system design preferences. CA enables the capturing of individual and group preferences via relative importances of features and the application of user clustering techniques. This analysis type could support requirements management for customer-oriented IS (Kabbedijk et al. 2009). Thus, it could be a fundamental method for release planning and selecting relevant features based on user choices. In addition, having design feedback from a large

number of users is facilitated via the conjoint surveys, which is also a concern in research on mass-market IS where wide-base end-users demand new requirement engineering approaches (Jarke et al. 2011; Todoran et al. 2013; Tuunanen et al. 2010).



**Business model design:** CA allows one to measure design tradeoffs between functional, non-functional, and economic properties, as it is the case for information privacy studies that mainly measure tradeoffs between privacy and monetary values on online channels (Krasnova et al. 2009). Thus, it can be used to evaluate the highly perceived value propositions of specific business models (e.g., IoT systems' value propositions (Derikx et al. 2015). It is also applied to support pricing decisions based on the WTP approach (e.g., Koehler et al. 2010; Mann et al. 2008). In such scenarios, CA serves as an estimation method for consumer utilities for different price levels, which then enables the determination of attractive prices or bundle prices. Pricing can be also done in addition to a channel selection scenario where the consumer decides on the preferred format of information delivery as in the case of e-commerce (Berger et al. 2015). Moreover, CA can be applied to measure preferences for partnership related characteristics; for instance, migration among PaaS providers (Giessmann and Stanoevska 2012). These presented scenarios can be used individually or can be combined to support business model development. CA covers application areas that correspond to elements of the business model canvas (Osterwalder and Pigneur 2010), including value delivery, configuration, and capture aspects. Thus, CA can be used ex-ante to design business model elements based on consumer research for new mass-market IS. For instance, Tesch (2016) suggests CA as a method for scenario planning when designing IoT business models.

**IS evaluation:** Besides the initial design phase, CA could be useful in the evaluation of current systems. CA has been proven to be useful in decision-making for strategic purchasing of IS in organizations (Benlian and Hess 2010, 2011; Keil and Tiwana 2006). These studies determine factors that drive software system selection in an organizational context at a managerial level. They mainly reflect weights of evaluation criteria governed by attribute tradeoffs to help assess existing systems and their selection or purchasing decisions. This could involve studying typical evaluation criteria of packaged systems (such as functionality, cost, ease of use, implementation, customization, and integration) and extending that to domain-specific and vendor-related criteria. Also, from a user perspective, CA allows one to measure adoption and to predict consumers' intentions to use of IS products (e.g., Chen et al. 2008, 2010; Nikou et al. 2012, 2014; Schaupp and Bélanger 2005). In fact, a review of TAM applications in IS by Lee et al. (2003) indicates that CA is one of the data analysis methods used to measure the acceptance of new IS with the TAM model. This shows the conjoint method's applicability in measuring the adoption of new technologies in organizations, considering product attributes and the external factors that surround them

(such as vendor-related aspects) in addition to user perceptions. This could also be based on clustering of user groups to determine target segments.

**Business model evaluation:** Finally, CA can be used to validate and refine business models of existing products in an ex-post approach. This could be enhanced by market simulations and predictions based on estimated preferences (Giessmann and Legner 2013). The calculated utilities allow one to predict user preferences for different hypothetical attributes combinations. Market simulations based on CA are mainly employed to obtain benchmarks and for competitive analysis. This enables comparing product combinations and their overarching business models with other vendors via the prediction mechanism and to generate virtual market shares for multiple vendors. Further, the ability to perform attribute variation analysis to study the effects of varying attributes on market shares is important in identifying which elements of the business model could be refined or should be changed for better outcomes. Thus, software vendors would be aware of business model elements that can have significant impacts on users' choices.

### **5.3 The Need for Domain-Specific Adaptation**

#### **5.3.1 Methodological Guidance for Applying CA in IS**

In view of the large number of variants and application areas, we need domain-specific adaptations and methodological guidance for conducting CA studies in IS. Methodological guidance needs to be developed concerning the following aspects: In a first step, there is a need to support the selection of the appropriate CA variant that fits the IS domain's specificities and the study's objectives. Depending on the scenarios outlined in Section 5.2 and the CA variant type, data collection (e.g., hybrid or adaptive), as well as the econometric and statistical methods to estimate utility functions may vary. In a second step, guidelines would be useful for integrating them into the existing methods for requirement engineering, business model design, and IS evaluation.

#### **5.3.2 User Preference Modeling**

CA's success relies on the choice of right attributes, which can lead to valuable preference models and actionable insights. However, "little guidance is given in how to select them, other than to use qualitative research methods (one-on-one interviews, focus groups), and possibly open-ended survey items as a guide" (Bradlow 2005, p. 322). To address this issue for CA studies in IS, researchers could develop **user preference models** that represent the relevant attributes from a user perspective, covering functional, non-functional, economic, and operational dimensions. These models would consist of validated catalogues of attributes and attribute levels based on previous studies of CA with additional empirical investigations, increasing the CA method's practicality. In line with Bradlow (2005), the number of attributes should also be discussed in greater detail. CA has been shown to operate quite well when the number of attributes in a profile is within a moderate range (less than 8) (Backhaus et al. 2010, 2011). However, when describing IS, the number of features may be much higher (15 to 20 or more). Two common practices in such situations are (a) to utilize partial profiles (Green and Krieger 1990) where each profile contains an experimentally designed attributes subset, or (b) self-explicated conjoint (Green and Krieger 1987) in which the importances of attributes and desirability of levels are collected in a self-report, in a one-at-a-time manner (Bradlow 2005). An idea for future research in this area would be the development of partial profile conjoint (Netzer et al. 2008), presuming that not all attributes interact with one another. These results would allow researchers to construct their conjoint studies rapidly and avoid the time-consuming task of constructing attributes and levels from scratch.

Besides domain-specificity, these models could be also categorized based on the study purpose to reflect methodological applications of conjoint analysis. For instance, technology acceptance research can benefit from previous evaluation studies based on TAM (e.g., Mahindra and Whitworth 2005) to develop future reference models.

## **6 Conclusion and Future Research**

Market research techniques are popular for new product development, but have to date not been fully embraced in IS research. By conducting a systematic longitudinal literature review and analyzing 46

studies, we have gained detailed insights into CA's applications in IS. We conclude that CA can be adapted to several application areas in IS, and can have advantages in understanding user preferences. Our findings are of interest for both IS theory and practice. For academics, we make three primary contributions: First, our review assesses methodological setup or method variants from previous CA studies in IS. Second, we provide guidance for future studies by proposing a reference framework for applications of CA in IS. Our framework ideally covers the two phases of design and evaluation of IS starting from the core system and involving business model elements. Third, we suggest domain-specific adaptations of CA that should be addressed in future research. We see empirically validated user preference models as a prerequisite for leveraging CA in the design and evaluation of mass-market IS.

For practitioners, we show that CA could be employed in specific scenarios to support the design of ISs and their business models. The method could serve requirement elicitation and prioritization techniques for integrating user preferences in the development of new systems, applications, and service offerings. Through concept evaluation, customers can assess a complete product offering and can rate it based on their stated preferences, leading a design process with initial product preferences. Further, CA combines human intuition with a systematic approach that quantifies preferences (via a relative importance measure) for further feature selection from a defined set of attributes and attribute levels. Moreover, the method allows for the derivation of decision models for user selection and adoption patterns. We have discussed that the market simulation techniques advance a new proposition that can support the design, evaluation, and refinement of existing systems. This could support the ex-post evaluation of systems and business models.

Future research should explore how the CA method can be further instantiated and integrated into existing methodologies in the areas identified in Section 5.2. This could be achieved through ex-ante evaluation of the method with domain experts, and through empirical studies for validation. Another research opportunity is the methodological contributions for the domain-specific adaptation of CA, for instance through the creation of user preference models for typical categories of IS solutions and domains.

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## 8 Appendix

<b>Study</b>	<b>Study objectives (as stated by authors)</b>	<b>Domain</b>	<b>Purpose</b>	<b>Type</b>	<b>Sample</b>	<b>Subjects</b>
Bajaj (2000)	identify the factors that senior IS managers across mid-sized to large organizations would consider when making decisions regarding the adoption of a new architecture for their organization	ES	DM	TCA	23	Managers
Brinton Anderson et al. (2002)	study the relative values of these factors in the decision models of senior IS managers when evaluating software for use by their organization	ES	DM	TCA	24	Managers
Hann et al. (2002, 2007)	explore individuals' tradeoffs between the benefits and costs of providing personal information to websites	O	IP	TCA	184	Students
	estimate an individual's utility for the means to mitigate privacy concerns	O	IP	TCA	268	Students
Zubey et al. (2002)	suggest the VoIP technology attributes that best meet users' needs	MC	D	TCA	254	Customers
Baek et al. (2004)	examining customers' WTP for online games	O	P	TCA	179	Customers
Brodt and Heitmann (2004)	drills down to the importance of service attributes	MC	D	ACA	103	Students
Keen et al. (2004)	investigate the structure for consumer preferences to make product purchases via three available retail formats: store, catalog, and the Internet	EC	C	TCA	290	Customers
Kim (2005)	build descriptions of hypothetical mobile service packages	MC	D	CBCA	1000	Customers
Mahindra and Whitworth (2005)	a conjoint analysis of the contribution of these factors in a proposed corporate software purchase of browser	O	DM	TCA	28	Students
Mueller-Lankenau and Wehmeyer (2005)	gathering first insights into consumer preferences for mobile couponing	MC	D	TCA	125	Students
Schaupp and Bélanger (2005)	examining the roles of several technology, shopping, and product factors on online customer satisfaction	EC	A	TCA	188	Students
Haaker et al. (2006)	assess which combination of services and prices are the most attractive for users	MC	P	TCA	156	Customers
Keil and Tiwana (2006)	first empirical investigation of the relative importance that managers ascribe to various factors that are believed to be important in evaluating packaged software	ES	DM	TCA	126	Managers
Bouwman et al. (2008) Bouwman and van de Wijngaert (2009)	what are the relevant context-related, individual and technological characteristics that play roles in the use of mobile technologies by police officers, and where they conflict with the requirements identified by police stakeholders	MC	D	TCA	23	Stakeholders
	A		TCA	106	Customers	
	examines the role and explanatory values of context-, task-, and information-related characteristics vis-a-vis individual characteristics in relation to the adoption of mobile technologies and applications	MC	A	TCA	106	Customers
Chen et al. (2008, 2010)	grasp the relative preference level of each attribute and its corresponding experience level	EC	A	TCA	20000	Students
	understand which factors influence consumer purchase intentions and these factors' relative importances	EC	A	TCA	1567	Students
Mann et al. (2008)	how consumer utility and WTP in one specific channel may be correlated with time of availability	O	P	ACA	489	Customers
Krasnova et al. (2009)	first attempt to assess the value of privacy in monetary terms in this context	O	IP	ACA	168	Students
Schwarz et al. (2009)	provide theoretical rationalizations on the confluence of pertinent attributes when selecting an external source for an application service	ES	DM	TCA	84	Managers
Song et al. (2009)	estimate customer preferences and the relative importances of service factors	MC	D	TCA	-	Students
van de Wijngaert and Bouwman (2009)	obtain insights into the factors that influence the use of wireless grid applications before a given technology is actually introduced on the market	MC	A	TCA	257	Students
Benlian and Hess (2010, 2011)	derive implications on the relative importances IS managers ascribe to evaluation criteria in ERP selection based on the different personality traits of IS managers	ES	DM	ACA	232	Managers

	the first empirical investigation to compare the relative importances of evaluation criteria in proprietary and open-source EAS selection	ES	DM	ACA	358	Managers
Doerr et al. (2010)	examines, from a customer perspective, the importances of the different features of premium offers	C	P	ACA	132	Customers
Head and Ziolkowski (2010)	provides insights into how students value various mobile phone applications and tools	MC	A	ACA	188	Students
Ho et al. (2010)	finds the levels of tradeoffs between monetary rewards provided by e-payment gateways and buyers' protection excess imposed by e-payment gateways	EC	IP	TCA	1795	Customers
Koehler et al. (2010)	analyze customer preferences for cloud services	C	P	CBCA	60	Customers
Fagerstrøm and Ghinea (2011)	expand our understanding of approach/avoidance behaviors by examining the motivating impact of price relative to online recommendation at the point of online purchase	EC	A	TCA	270	Customers
Fritz et al. (2011)	empirically estimate consumers' reactions to the offer of fair use flat rates	MC	P	CBCA	263	Students
Giessmann and Stanoevska (2012)	empirical investigation of the essential and necessary characteristics of PaaS from the perspective of third-party developers	C	D	ACBCA	103	Customers
Hu et al. (2012)	provide a fuller conceptualization of technology design and advance our understanding of the impacts of essential design factors individually and jointly	MC	D	CBCA	105	Students
Nikou et al. (2012, 2014)	an attempt to understand the criteria and expectations of consumers to opt for a specific platform from a device manufacturer or operator	MC	A	TCA	88	Students
	determine the most important characteristics of the mobile platforms	MC	A	TCA	166	Customers
Nevo et al. (2012)	understand the relative importance of meta-memory in the transactive memory processes in order to fit the best technology support for each process	ES	D	TCA	180	Customers
Choi et al. (2013)	assumes a consumer utility function for tablet PCs that reflects the variety of consumer preferences	MC	D	CBCA	389	Customers
Luo et al. (2013)	identify a hierarchy of importance concerning the critical factors influencing the adoption of mobile offices	MC	A	CBCA	101	Customers
Weinreich and Schön (2013)	analyze customer preferences for automation of service processes in the unified communications (UC) industry and derive managerial implications for optimal service design	ES	D	TCA	34	Customers
Burda and Teuteberg (2014, 2015)	what preferences do end-users have in their choice of cloud storage services when employed for the purpose of personal archiving and the relative importances of certain service attributes	C	A	CBCA	340	Students
	uncovering the preference structure and tradeoffs that users make in their choice of storage services when employed for the purpose of archiving	C	A	CBCA	340	Students
Daas et al. (2014)	determine the reservation prices of the services and to assess which price-bundle combinations are most attractive	C	P	TCA	47	Customers
Lee and Rhim (2014)	investigate user preferences for the ISs in order to achieve user satisfaction	ES	A	TCA	55	Customers
Berger et al. (2015)	explore differences in consumer preferences and WTP between offline and online formats	O	C & P	CBCA	506	Customers
Derikx et al. (2016)	studies whether and how privacy concerns for connected car services can be compensated financially	IoT	IP	CBCA	55	Customers
Pu and Grossklags (2015)	quantify the monetary value people place on their friends' personal information in a social app adoption scenario	O	IP	TCA	201	Customers
Tamimi and Sebastianelli (2015)	estimate the effects of selected e-tailer and product-related attributes on a consumer's likelihood of making a particular online purchase	EC	A	TCA	122	Students
Yusuf Dauda and Lee (2015)	analyze the technology adoption pattern regarding consumers' preferences for potential future online banking services in Nigeria's banking industry	O	A	CBCA	1291	Customers
Siegfried et al. (2015)	provide a nuanced analysis of platform and environment signals that drive app installation and contribute to a better understanding of the underlying decision process	MC	A	TCA	121	Customers
Cwaikowski et al. (2016)	measure WTP for legal rather than illegal content as it compares to valuation of other features of the product	O	P	CBCA	228	Customers
Mikusz and Herter (2016)	investigate how consumers evaluate value propositions of connected car services with a high option and/or indirect value-in-context	IoT	D	TCA	84	Customers

**Table 5. Overview of CA Studies in IS**