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Abstract
Information technology-based innovation involves considerable risk requiring foresight; yet our understanding of the way in which managers develop the insight to support new breakthrough applications is limited and remains obscured by high levels of technical and market uncertainty. This paper applies discrete choice analysis to support improved empirical explanation of how and why decisions are made in information systems. A new experimental method based on information acceleration is also applied to improve prediction of future IS service strategies. Both explanation and prediction are important to IS research and these two behaviourally sound methods complement each other. Specifically, the combination of information acceleration and discrete choice analysis removes misspecification artefacts from response variability and generates more accurate parameter estimates that better explain IS decision making.

Keywords
experimental research, IS service strategy, decision-making, discrete choice analysis, information acceleration

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Running head: Information acceleration in IS

Designing IS Service Strategy: An Information Acceleration Approach

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Designing IS Service Strategy: An Information Acceleration Approach

Abstract

Information technology-based innovation involves considerable risk that requires insight and foresight. Yet, our understanding of how managers develop the insight to support new breakthrough applications is limited and remains obscured by high levels of technical and market uncertainty. This paper applies a new experimental method based on "discrete choice analysis" and "information acceleration" to directly examine how decisions are made in a way that is behaviourally sound. The method is highly applicable to information systems researchers because it provides relative importance measures on a common scale, greater control over alternate explanations and stronger evidence of causality. The practical implications are that information acceleration reduces the levels of uncertainty and generates a more accurate rationale for IS service strategy decisions.

Keywords: Experimental research, IS service strategy, decision-making, discrete choice analysis, information acceleration

While good hockey players skate to where the puck is,
a great hockey player skates to where the puck is going to be.

(Wayne Gretzky)

Introduction

The development of an information systems (IS) service strategy is a challenging combinatorial problem that requires the allocation of appropriate resources to connect information technologies, to coordinate suppliers and respond to the needs of internal units and end–clients. In common with Gretzky, those managers with the skills and insight to manage this complexity, and the foresight to identify where the next business opportunities *are going to be* are likely to garner the greatest returns from investments in IS. Although the demand for executives with such insight and foresight is great, recent industry reports reveal that these skills are in short supply (Dubie, 2007). Accordingly, very few firms tend to realise the full potential of their IS investments (Sauer & Cuthbertson, 2003).

To improve this situation, we need rigorous quantitative research methods that are better aligned with the decision strategies and processes used by those managers with responsibility for IS investments. These methods must be able to guide strategic planning, and deal with heterogeneous preference structures. They must also be able to control for information variance, recognising that not all managers have access to the same information, or have the same information processing abilities. In the absence of such methods, executives are forced to base their IS investment decisions on idiosyncratic criteria and simple heuristics that have been shown to deliver inconsistent results (Lyytinen & Robey, 1999). Such ad-hoc decision-making has been shown to increase the cost of IS investments as suppliers take advantage of the resulting information asymmetry (Johnson *et al.*, 2003).

In this paper we evaluate a new quantitative approach that captures the characteristics of decision-making in a way that is behaviourally sound, and is consistent with the precepts of decision-making theory. Specifically, we propose the use of a discrete choice experiment (DCE) and information acceleration in which the characteristics (attributes)

of interest are systematically varied using statistical design theory to control for information uncertainty. Pioneered at the Massachusetts Institute of Technology (MIT) in the early 1990s (Urban *et al*., 1996, 1997), and extended by the Future Choice Initiative (Devinney *et al*., 2004), the combination of DCE and information acceleration has been used successfully to generate new insight across a diverse range of IT and other applications. The technique begins with the construction of sets of alternative scenarios that allow respondents to better understand future choice situations that they may face. In particular, multimedia technology is used to ‘‘accelerate’’ respondent learning and experience, enabling the researcher to develop and implement DCE surveys that include a wide array of information, features, risk/benefits and contexts. Accelerated understanding and experience is essential to enable respondents to make informed decisions about future alternatives where there may be no precedents on which to base their decisions.

The remaining sections of the paper are organised as follows. The next section provides a background to complex decision-making and positions the study within a typology of quantitative methods. Next we move onto the heart of this paper and describe the proposed methodology. This is followed by an illustrative empirical application of information acceleration to the delivery of IS services. The IS service function is central to most contemporary businesses and we argue that it represents a singularly good example of how information acceleration can be applied to address uncertainty in a complex organisational setting. The substantive findings suggest that information acceleration can be used to rigorously evaluate the insights required to manage IS service environments.

Understanding Complex Decisions

Appreciating how managers make decisions and judgements when faced with uncertainty is a critical first step in improving the prospects of IT investments and IS strategy. According to Stevenson *et al*. (1990), complex choices are considered decisions when the set of alternatives from which one chooses are valuable to the decision-maker, and there is a high stake in the choice outcome. Judgements, on the other hand, involve choices where the alternatives from which the decision-maker chooses are categories or ratings for a particular stimulus. While both types of choices can involve uncertainty, within this

paper we focus on decision-making as we contend that these types of choices are better aligned with the real world where combinatorial problems and information asymmetry are common. Though judgement processes are helpful in understanding how managers evaluate individual stimuli, they have limitations in explaining decisions that involve complex trade-offs between many stimuli.

Bernoulli (1738) is credited with providing the first formal explanation of decision-making. This was later extended by von Neumann & Morgenstern (1947) to form the foundation of what is referred to as *utility* theory. This theory proposes that people make decisions in light of the expected benefits, or utility, that will result from such decisions. As Taussig (1912) proposed "An object can have no value unless it has clear utility. No one will give anything for an article unless it yields him satisfaction. Doubtless people are sometimes foolish, and buy things, as children do, to please a moment's fancy; but at least they think at the moment that there is a wish to be gratified."

Against this backdrop, managers are viewed as rational persons who are able to estimate the probability associated with the alternatives available in the decision task, and will select the outcome that has the greatest probability of maximising utility. However, as one might expect, people are typically not entirely rational, or even aware of all the factors that enter into their decision-making processes—creating serious shortcomings that influence its efficacy (for examples see Baron, 1994).

Simon's (1955) simpler decision-making model was based on the concept of *satisficing*, whereby decision-makers get approximately what they want but within the constraints of a limited decision-making process. An example of this alternative strategy can be seen in the process that managers would go through in the search for a new ERP system. Under utility theory a manager would evaluate every system in the market, and form a linear equation based on all the pertinent variables before selecting the system that had the highest overall utility score. With satisficing, however, managers would just evaluate systems with certain features (i.e., decision attributes) or that met certain conditions (e.g., below a given price threshold), stopping when they found one that was good enough.

More recent work on bounded rationality forms the basis of *prospect* theory (Kahneman & Tversky, 1979). This theory encompasses the best aspects of utility theory and satisficing, while solving many of the problems that each presented. A key feature of prospect theory was that decision-makers place greater emphasis, relatively speaking, on losses than gains. For instance, if managers were given the choice between two competing ERP systems, it is more likely that an executive would, on average, choose the system that required the least change and posed the smallest risk of reprisal to the decision-maker, even if that system was deficient in terms of features. This reinforces the complex nature of strategic decision-making, and emphasises the importance of identifying research methodologies that acknowledge and control for different decision-making strategies that are employed by managers. The next section will explore these strategies in greater detail.

Decision-Making Strategies

A particular strategy, or combination of strategies, can be characterised across several dimensions (e.g., Stevenson *et al*., 1990; Bettman *et al*., 1998; Lye *et al*., 2005). In Table 1, we categorise the main decision-making strategies in terms of: (1) a decision-maker's desire for accuracy (Payne *et al*., 1993), and (2) their need to reduce cognitive effort (Bettman *et al*., 1998). Desire for accuracy is conceptualised in terms of whether the decision-making strategy involves a compensatory trade-off or not. Compensatory strategies are viewed as being more accurate than non-compensatory strategies because they implicitly recognise the interdependencies that exist between the different elements of a decision. They allow the decision-maker to balance deficiencies in one area against strengths in another; and in doing so, more accurately reflect real-world decision-making.

Table 1: Decision-making Strategies

		Accuracy	
		Compensatory	Non-Compensatory
Complexity/ uncertainty	Holistic processing	Equal weight	Satisficing
		Weighted additive strategy	Conjunctive
	Attribute level processing	Majority of confirming dimensions	Lexicographic
			Elimination by aspects

However, compensatory decision-making is not easy because it assumes that access is available to accurate and exhaustive information on the attributes of the alternatives in a decision-making task. Such strategies also involve extensive information processing and cognitive effort to arrive at a decision. The desire to reduce cognitive effort is why decision-makers employ non-utilitarian decision-making strategies and operate with bounded rationality. In practical terms, decision-makers employ heuristics in an effort to reduce cognitive effort—that is, they focus only on certain attributes and establish arbitrary thresholds, rather than making holistic comparisons among alternatives.

In measurement terms, compensatory decision strategies are measured on a relative scale wherein the value of an attribute or alternative is influenced directly by the importance placed on the other options available. For instance, in the ERP example introduced above, the ease of integration of an ERP system with existing legacy systems might compensate for a higher price. That is, a IS manager may choose to pay a little more for a system that fits better with their existing IT infrastructure. The decision-maker may place equal weight on the attributes, whilst at other times they may weight these attributes differently (weighted additive strategy). An example of the latter might would be to place twice as much importance on IS integration when choosing between two ERP systems. Another compensatory strategy is the majority of conforming dimensions (Russo & Dosher, 1983) where competing choice alternatives are evaluated across all constituent attributes, and the alternative that has highest values across more attributes (or dimensions) is retained.

Non-compensatory strategies are closely aligned with judgment tasks and result in an absolute scale wherein the value of one attribute or alternative is not directly influenced by the value placed on the other choice options available. For example, in the ERP example used above, the information on ease of integration with existing legacy systems would be processed separately to the pricing information. Non-compensatory strategies are characterised by selectivity in the processing of information. For instance, in a simple ‘satisficing’ strategy (Simon, 1955) the first alternative evaluated that meets the decision-makers expectations across all attributes is chosen, even if it is not the optimal choice. Alternatively, in a ‘lexicographic’ (Fishburn, 1974) or ‘elimination by aspects’ strategy

(Tversky, 1972) the decision-maker uses either a deterministic or probabilistic process to selectively consider the attributes of the choice alternatives.

Despite numerous expansions on the decision-making strategies presented in Table 1, primarily through the identification of explanatory heuristics and biases (Kahneman, 1991), these strategies capture the essence of the way decision-making varies over people and situations. While one individual may make choices by carefully trading off the pros and cons of alternatives (a compensatory rule), another may make that same decision by choosing that which is best on the most important attribute (a non compensatory rule). Further, decision processes are conditioned by situational factors as choice set size (whether determined exogenously or endogenously), the levels attribute variation and the methods of communication (Adamowicz *et al*., 2008). These observations introduce heterogeneity to the measurement process that can confound the efficacy of traditional measurement approaches used in IS research. Next, we propose a method to better model the drivers of decision-making in an IS context

The Science of Preference Methods

While methods such as case studies (Benbasat *et al*., 1987; Lee, 1989), action research (Kaiser & Bostrom, 1982; Wood-Harper, 1985) and survey techniques (Cheon *et al*., 1993; Im & Grover, 2003) are well suited to the multi-layered, exploratory nature of work in IS, these methods are limited in terms of the decision-making inferences that can be drawn. For example, the absolute measures obtained by typical survey methods based on reflective and formative measurement models are not suited to capturing the trade-offs that managers make when pursuing benefits. Even though the use of structural equation and latent class modelling can provide evidence of what variables play a role (Lewis *et al*., 2003; Coltman *et al*., 2007), they cannot capture the trade-offs involved in compensatory strategies directly. Another key limitation of these methods is that they downplay the context of IS decision-making. Diverse contexts make it difficult to design surveys that capture all relevant variables.

To overcome these limitations IS researchers have recently begun to use stated preference methods to elicit individual preferences for goods, courses of action or more general

decision-making. For example, Raghu *et al*. (2009) used a binary discrete choice technique known as contingent validation to assess "willingness to pay" for open source software. Their results indicate that the availability of alternative open source software will have little impact on a consumer's willingness to pay for Microsoft Office software.

The controlled environment in DCE and other stated choice methods provides a means of addressing the heterogeneity of measurement contexts. Experimental design theory allows the researcher to plan the experiment to provide a desired level of accuracy (Burgess & Street, 2005; Street *et al*., 2005). The balanced design ensures that the main effects of attributes are identifiable and orthogonal to the impact of the information acceleration. The need for probability sampling is also less acute in an experimental method because randomisation is used to control for perceptions regarding the scenario that could otherwise act as a confounding variable. Hence, validity is more concerned with the generalisability of the experimental context, rather than on the particular backgrounds of participants.

Modelling Discrete Choices

Pioneered by McFadden (1986), the winner of the 2000 Nobel Prize in Economics, the discrete choice approach focuses on both the economic value of individual choices and the ways in which researchers measure and predict these choices. The scientific approach for modelling individual choices is based on information integration theory in psychology (Anderson, 1981) and random utility theory in economics (Ben-Akiva & Lerman, 1985; Hensher & Johnson, 1980). Random utility theory is a theory about the behaviour of humans, not numbers. It posits the existence of a latent construct that is similar to traditional utility theory in that it assumes that decision-maker is able to discriminate, rationally, between alternatives in a choice task. However, an individual's utility for choice alternatives is latent. In other words, it exists in an individual's head and cannot be observed directly by researchers. Random utility theory proposes that these latent utilities can be decomposed into a systematic or explained component, and a random or unexplained component. The relationship can be expressed as:

$$U_{in} = V_{in} + \varepsilon_{in}$$

Where U_{in} is the latent or unobserved utility that individual n associates with choice option i, V_{in} is the systematic or explained component of utility that individual n associates with option i, and ε_{in} is the random component associated with individual n and option i. In organisational contexts, the decision-maker seldom has access to perfect information and a central aim of the researcher is to simulate situations derived from realistic variations of the decision attributes.

A respondent's response to systematic manipulations of attributes is used to derive underlying utility preferences (McFadden *et al*., 2005). Each choice draws on Thurstone's (1927) law of comparative judgment to place attribute choices on a common scale that is consistent with random utility theory and can be modelled in the form of a multinomial logistic regression (Luce & Suppes, 1965; McFadden, 2001). The bounded rationality of decision-makers is directly accounted for in the experimental design which explicitly considers the notion of value (utility) to establish reference points. Importantly, DCE has been found to produce preference structures that closely simulate those in real markets, as well as the decision strategies they use to resolve such choices (Louviere *et al*., 2000).

However, DCE have some limitations that need to be acknowledged. First, great care needs to be taken to ensure that all (or at least as many as possible) of the drivers of choice are identified and expressed in terms understood by decision-makers (Swait & Ben-Akiva, 1987). In other words, one must ensure that the choice attributes are derived from theory or from preliminary exploratory work. One significant caveat to the DCE approach is when decision-makers are required to make choices from amongst alternatives that are not well understood (e.g., choices regarding innovative technologies). As noted by Krieger *et al*. (2003), there is a need in such cases for "information bridges" that connect current understanding to future experience. Information acceleration provides the information bridge whenever current understanding is associated with uncertainty.

Accelerating Understanding to Reduce Uncertainty

One of the great challenges associated with managerial decision-making, is that managers are expected to make choices without access to complete and accurate information. First developed in the early 1990's, the information acceleration technique is based on the premise that if you can realistically give the customer (manager or IT decision-maker), today, the same experience and information they will have in the future, when they will actually consider new product or service, then data regarding information conditions, preferences and intentions can be collected and modelled (Urban *et al*., 1997). Information acceleration addresses the uncertainty of future states by providing sufficient information to allow decision-makers to make more accurate choices or decisions.

Information technologies are used to create a virtual environment that reflects future decision contexts including the introduction of new technologies and the evolutionary paths that such technologies may take. The virtual environment usually includes richly coded information—diagrams, multimedia, and feedback loops—that allows the researcher to simulate the decision-making context (Reber & Millward, 1968). The central idea is to 'accelerate' the process by which decision-makers acquire information and experience new technologies and environmental changes. By guiding participants through this learning process, researchers can reduce uncertainty over the future context and then model stated preferences in these future environments. The reduction in uncertainty allows a rational model of choice to accurately capture the decision-making by minimising distortions created by cognitive biases.

One of the first information acceleration projects initiated was at Wharton's Alfred West Jr. Learning lab, where information acceleration was used to evaluate demand for a radically new electric car (Urban *et al* 1996, 1997). Forecasting demand for electric vehicles is a complex problem that requires more than an appreciation for current problems. Respondents were required to read a series of newspaper/magazine articles from the future and then assess vehicle details by interacting with a multimedia program that provided a full array of verbal, pictorial, video and text material. In an IT context, information acceleration has been used to measure the demand structures for a new

personal digital assistant with full voice recognition software and computer simulated communication (Coltman *et al*., 2006).

Illustrative Empirical Application

To illustrate the advantages of our method, we turn our attention to a common IS problem; namely, assisting managers to better understand how tangible and intangible IT resources influence the development of customised IS service strategies. For example, while the availability of complementary human resource is well accepted in the IS literature (Powell & Dent-Micallef, 1997), the contingent nature of benefits make it necessary to use relative measurement models that capture the compensatory strategies. Moreover, uncertainty over future contexts can lead to deviations from rational choice, resulting in uncertainty and boundedly rational decision-making (Simon, 1955).

Traditional IS methods rely on post-hoc statistical analysis to try and ameliorate the effect of context and provide no means of accurately capture decision strategies in future decision contexts where uncertainty undermines models of rational choice (Gigerenzer, 1996). This is where information acceleration is essential. By accelerating understanding of new decision contexts, we can take managers to a decision-making space where the introduction of new technologies, and the evolutionary paths that such technologies may take, can be observed directly. The influence of the decision-making context can then be interpreted directly in terms of the manager's understanding of the role that IT resources play in the development of innovative IS service strategies.

The Information Acceleration Manipulation

The information acceleration manipulation used in this empirical application was delivered over a web-based interface that sequentially presented richly coded information. The use of carefully structured information allowed the information acceleration to be kept to a tractable length while still supporting accelerated learning processes. Keeping cognitive load to manageable levels is important in allowing learning to occur (Sweller, 1988). The information acceleration included a diagrammatic representation of IT service iterations. This was supported by preceding and subsequent textual description and a set of ordered response questions.

The visual and textual description of IS service interactions was developed as the result of extensive qualitative research that included semi-structured interviews with five IS managers responsible for IT service strategy decisions. The information acceleration task provided a visual representation of different IS service interactions, which were themselves linked to an earlier definition of an IS service process flow. This process information was provided to all respondents to control for random effects associated with individual level differences. The process flow definition was common between the participants who received the acceleration and those that did not.

Delivering the information acceleration through an online medium provided a structured sequential learning path for each respondent. This started with a close description of the organisational context surrounding IT services. An animated diagram was then presented that visually represented the specific interactions involved in IT services. This micro-focus aimed to provide an understanding of the transactional content involved in the delivery of IT services that improved technology could afford. This was followed by a second section of text describing the potential new transactional structures that could be achieved. Finally, participants were asked to answer five Likert questions. These questions drew attention to contextual aspects of IT services, encouraging participants to reflect on the information they had received. This type of reflection has been shown to be important in learning processes (Schön, 1983).

The Discrete Choice Experiment

The sample for the experiment was drawn from a database of managers that were linked to a leading business school through practitioner workshops and executive classes. Potential participants were screened on an index of three five-point Likert scale items relating to the importance of IS to 'firm performance', 'value creation' and their 'industry' to increase relevant experience and motivation (Dillman, 2000). Participants were selected if their combined score on these items was greater than or equal to 14. This produced a sample of 75 participants. The sample size surpassed the 48 subjects needed to provide statistical accuracy under the experimental design (Louviere *et al.*, 2000). These participants had an average of 5.22 years of business experience. Comparison to those that had been screened out showed that the selected group had more experience

with IS support (p=0.002) and developing business processes (p=0.012) but were not significantly different on other demographics.

The instrument underwent several phases of development. First, we needed to identify relevant variables for inclusion in the experiment. In this regard, the design was informed by Larsen's (2003) taxonomy of IS success factors, and interviews with two senior IT managers. This led to the identification of three attributes (tangible IT resources, intangible IT resources, and IS customisation) and three relevant controls (cost advantage, competitive intensity, and governance mode). Second, the instrument was assessed for face validity with a representative sample of IT managers using semi-structured interviews and a pre-test. All preliminary testing supported the attribute selection and definitions. Finally, non-response bias was evaluated using ex post statistical techniques. This testing indicated no significant differences between early and late respondents (Armstrong & Overton, 1977).

Substantive Hypotheses

In order to make the empirical illustration as realistic and relevant as possible, we proffer the following two research hypotheses to provide a context for the ensuing analysis.

H1: *Research attributes (i.e., tangible IT resources, intangible IT resources, and IS customisation) will be strategically important to managers*.

H2: *Receipt of the information acceleration will reduce uncertainty as observed in reduced attenuation in the strategic importance of the research attributes.*

Support for the first proposition is drawn from the extant IS literature. For instance, IT resources are an identified source of competitive advantage (Powell & Dent-Micallef, 1997), and have been shown to positively increase performance (Brynjolfsson & Hitt, 2000). According to Melville *et al.* (2004), these resources can be classified as either tangible resources or intangible resources. Tangible resources include IT infrastructure such as technology and software applications that utilise the infrastructure (Broadbent & Weill, 1997). Intangible resources, on the contrary, include human and organisational

factors in the successful implementation of IS services (Tippins & Sohi, 2003; Hatch & Dyer, 2004).

Likewise, the customisation of IT processes has been shown to facilitate the provision of specialised IS services, which in turn allow differentiated product and service offerings. Customisation of IT can be important in making technology work in a specific context (Feeny & Willcocks, 1998). Research has identified a number of contextual features, such as human resources and firm culture that IS should be aligned to. The customisation of IT processes also impacts performance outcomes by allowing firms to pursue distinctive IS service strategies (Richard & Devinney, 2005). The benefits of customisation are closely related to the possession of specialised assets that allow firms to achieve competitive advantage (Teece, 1986). Greater customisation of IS allows firms to produce more strongly differentiated products and services (Kathuria et al., 1999).

The second proposition builds on prior arguments already made about the influence of uncertainty on the decision-making process. In particular, uncertainty has been shown to lead to the adoption of simplification strategies and heuristics (Schwenk, 1986). These strategies seek to make the cognitive task of decision-making under uncertainty less taxing (Festinger, 1957). These heuristics that can produce a range of systematic errors include: the framing effect, overconfidence and cognitive biases such as those associated with availability, representativeness, anchor and adjustment (Tversky & Kahneman, 1974). The impact of these heuristics can be observed in the deviations from the decision that would be made under rational choice in the absence of uncertainty. Moreover, in the face of bounded rationality decision-makers will be biased towards less risky gains relative to alternatives that are perceived as higher risk. This suggests that the presence of uncertainty will attenuate the role of attributes in observed strategic choices.

To ensure that the observed effects were indeed attributable to the information acceleration manipulation, a range of variables that have been shown to influence the selection of an IS service strategy were also included in the experiment as controls. The most important of these—*cost advantages*, *competitive intensity* and *governance mode*—were included as attributes in the experiment. This allowed each control to be measured directly and their influences separated from the research variables. Other features such as

organisational size were controlled by direct statement in the information establishing the experimental context that was shared by all participants.

Empirical Results

Statistical analysis of the data collected was based on a conditional multinomial logistic regression (MNL) model (McFadden, 2001). The MNL model makes certain assumptions about the distribution of errors that must be tested before progressing to an examination of the model parameters. Correlational analysis and the Hausman & McFadden (1984) specification test were applied to test the independence of irrelevant alternatives (IIA) assumption of the MNL model. These supported the IIA requirement that the presence or absence of alternatives has no impact on the utility placed on the selected option.

Tables 2a and 2b provide the results of MNL analysis. The results of the models strongly support H1 and the impact of the research attributes. Main effects were all highly significant and in the hypothesised direction. That is, managers asserted that higher levels of tangible IT resources, intangible IT resources and IS customisation were strategically important.

Table 2a: Acceleration Models – Fit Statistics

	Information Acceleration	
	No	Yes
Dependent Variable:	Choice	Choice
Number of cases	34	41
Log likelihood	-439.924	-495.817
Pseudo R^2	0.137	0.189
Likelihood Ratio χ^2	640.0548 ($p<0.001$)	687.1209 ($p<0.001$)

Table 2b: Model Parameters

	Information Acceleration							
	No				Yes			
	B	*SE*	*z*	*Sig.*	*B*	*SE*	*z*	*Sig.*
Research variables								
Tangible IT Resources	0.243	0.053	4.619	0.000	0.395	0.051	7.683	0.0 00
Intangible IT Resources	0.216	0.053	4.112	0.000	0.235	0.051	4.610	0.000
IS Customisation	0.189	0.055	3.430	0.001	0.390	0.056	6.956	0.000
Control variables								
Cost Advantage	0.265	0.053	5.027	0.000	0.378	0.051	7.366	0.000
Competitive Intensity	-0.218	0.053	-4.135	0.000	-0.140	0.051	-2.754	0.006
Governance Mode	0.117	0.051	2.295	0.022	0.055	0.047	1.160	0.250

Table 3 shows how a shift in levels directly impacted aggregate decision-making. From this analysis, we see that tangible IT resources had a very strong impact on decision-making with a shift in level increasing the odds of selection of that alternative by 27.48% ($p<0.001$) for the standard participants and 48.36% ($p<0.001$) for the acceleration group. Indeed, both groups of participants weighed tangible IT resources as one of their top two influences. Managers also placed great importance on IS service strategies that involved higher levels of intangible IT resources ($p<0.001$). Participants preferred higher levels of IS customisation. The preference for a more customised offering was strongly positive in both the standard ($p=0.001$) and information acceleration groups ($p<0.001$).

These results suggest that decision-making of the participants subscribed to a rational choice model that matched IS theory. The MNL models described the decision-making effectively producing significant likelihood ratio chi-squares of 640.0548 ($p<0.001$) and 687.1209 ($p<0.001$). These models had Pseudo R^2 results of 0.137 and 0.189 for the standard and accelerated groups respectively. This was a 38% improvement in the variance explained. A likelihood ratio test on the improvement in the ability of the model to characterise the decision-making of accelerated participants produced a LRT statistic

of 13.96 (7 df). This suggested a significant improvement ability of the rational choice model adopted to explain the preferences of participants (p=0.026). The information acceleration improved the ability to explain the choices as being an application of random utility theory in an MNL model.

Table 3: Attribute Impact on Odds of Selection

		Information Acceleration	
		No	Yes
	Attribute Levels	*Impact on Odds of Choice*	
Research variables			
Tangible IT Resources	25% of requests online: 75% of requests online	27.48%***	48.36%***
Intangible IT Resources	50% of staff accredited: 90% of staff accredited	24.09%***	26.43%***
IS Customisation	25% processes customized: 75% processes customized.	20.78%***	47.64%***
Control variables			
Cost Advantage	0.25% cost disadvantage: +0.25% cost advantage	30.34%***	45.88%***
Competitive Intensity	2 BU competitors: 10 BU competitors	-19.62%***	-13.06%**
Governance Mode	Outsourced (external): In-house (internal)	12.39%*	5.65%

* p<0.05, ** p<0.01, *** p<0.001

Table 4 shows the Wald tests comparing the ability of each choice model to describe the decision-making of the two groups. The expected attenuation of the main effects was reduced by the provision of the information acceleration. As hypothesised in H2, all three of the relationships strengthened in the expected direction and two of the three were statistically significant. Tangible IT resources had a significantly larger impact on the decision-making of accelerated participants. The coefficient associated with the shift from having 25% to 75% of requests handled online increased from being 0.2428 for the low knowledge group to 0.3945 for the accelerated group. This produced a significant Wald statistic of 4.2629 (p=0.039). The accelerated participants placed greater positive

weight on the possession of intangible IT resources. This was consistent with the proposed relationship, though the coefficient was not statistically significant. Accelerated participants also chose significantly higher IS customisation (p=0.011). The difference in coefficients of 0.2008 suggested that accelerated participants appreciated the wider potential of customisation and made decisions that would utilise it more extensively. This is consistent with the growing share of firm spending on IT even in the face of mixed productivity results at an industry level (Morrison, 1996).

Table 4: Difference Score Wald Test

	Diff.	*Wald*	*Df*	*Sig.*
Research variables				
Tangible IT Resources	0.152	4.263	1	0.039
Intangible IT Resources	0.019	0.065	1	0.798
IS Customisation	0.201	6.545	1	0.011

This application illustrates how the DCE/information approach can provide causal evidence of the role of the attributes in decision-making. Importantly, the information acceleration was able to provide a clearer appreciation of the role of the attributes in future IS service delivery. The practical insights were meaningful, with customisation moving from being ranked as the fourth most important influence on the IS service strategy to be shown to be much more salient as the second most important influence on the selection of IS service strategy. In the absence of the acceleration, decisions were overly influenced by less important features. Mixed results from IT investments and a failure to meet expectations are hardly surprising when the weight placed on features can deviate this materially. The illustration provides evidence of the potential of decision-making distortions to influence IS service strategy and the ability for an information acceleration to reduce them.

Uncertainty over benefits biases decision-makers towards incremental improvements that fail to deliver on expectations. Uncertainty over future operating contexts can also lead to biased decision-making in favour the adoption of strategies that pursue better understood benefits (Kahneman & Tversky, 1979). Decision-makers exhibit a need for closure and

are more likely to focus on straightforward effects rather than those that are more cognitively difficult due to complexity or uncertainty (Kruglanski & Webster, 1996). The information acceleration technique used here addresses this issue by accelerating learning to provide understanding of new technologies and their evolution.

Discussion

We concur with claims by Brynjolfsson & Schrage (2009) that the future of organisational innovation is based on experimentation that has been facilitated by new digital technologies. The purpose of this paper has been to introduce greater rigour into the process by combining experimentation methods with multimedia technology.

Understanding decision-making requires an understanding of strategy process as well as strategy content. We know that managers inevitably choose between alternatives that represent complex trade-offs between the different benefits and costs; our measurement approach must match the decision-making models they use in such contexts. Though quantitative methods that are based on judgement tasks are the mainstay of traditional IS research, these methods rely on simplistic assumptions to make inferences that are seldom consistent with reality.

IS service decision-making produces a compensatory strategy as managers purposively work through recognised trade-offs. Survey-based, cross-sectional studies offer limited insight into how alternative options are evaluated. The DCE/information acceleration method used here is well suited to the evaluation of such strategies. This study shows the opportunity to apply new methodological contributions in marketing to organisational problems that remain unresolved in the IS domain. IS research can draw usefully on the information acceleration methodology to provide a more rigorous approach to IS questions. Extending the application of information acceleration methods from business-to-consumer interactions to an organisational context promises to allow a better understanding of IS decision-making.

We believe that failure to adequately align quantitative methodologies with the decision-making models used by managers has seriously impacted on IS performance. The IS literature is replete with stories of how IS service strategy has fallen short in providing

expected improvements in performance for most firms. Poor results from IT investment suggest serious deviations from optimal decision-making. The observed adoption of IT in many firms is poorly directed and mindlessly pursues the application of new technologies (Swanson & Ramiller, 2004). For many firms this has led to only incremental improvements in performance (Brynjolfsson & Hitt, 2000). The application included here provides just one example of how an information acceleration can be used to identify and correct such distortions. This data could be used to improve practical outcomes through the potential to embed the model in a decision support system (Little, 1970). A DSS could be used to train managers in understanding their own limitations and in evaluating their decisions.

In addition to future research applying the information acceleration approach in business there are opportunities to combine experimental and revealed data. Combining discrete choice analysis with complementary methods would add further strength to its contribution as a method in IS research. One important aspect is the ability to combine multiple methods, including stated and revealed preference data (Azevedo *et al*., 2003; Louviere *et al*., 1999). The nature of DCE lends itself to the simultaneous collection of survey material that can supplement experimental results. For instance, individual-level covariates can be easily collected by a short follow-up survey after a DCE is completed. This would allow the linking of decision strategies to experienced firm outcomes and performance implications. This would be an important contribution in linking IS strategy process and IS strategy content. This provides a means of strengthening the validity of IS research.

The difficulties of using traditional survey-based methods in IS research is compounded by the multi-level, cross functional nature of IT. The use of survey data with single informants confounds heterogeneity due to individual-level and organisational-level influences (Klein *et al*., 1994). DCE is able to separate these effects by having within-subject variance assess business unit and organisational level variables (Louviere *et al*., 2000); while the individual-level between-subject variance is modelled separately through balanced design. Information acceleration actively manipulates between-subject response by placing participants into an alternate decision environment (Devinney *et al*., 2004). The experimental design also allows many of the sources of firm-specific

heterogeneity found in real markets to be controlled (Bowen & Wiersema, 1999). Even though longitudinal data collection methods and post-hoc statistical analysis (e.g., fixed-effect regression models, factor analysis, cluster analysis, structural equation models etc.) can be used to minimise the resulting influence of this heterogeneity, only experimental approaches such as discrete choice-based methods can specifically control for the effects of within and between-subject heterogeneity.

The complexity of the IS environment and limited cognitive capacity of decision-makers creates scope for systematic distortions in the information managers consider. In addition to using covariates to measure these influences, the combination of DCE and information acceleration provides control over the composition of options and provision of information. This directly addresses limited search processes and imperfect information filters (Simon, 1955; March & Simon, 1958). We believe that it is better to control for such assumptions in the experimental design phase, and to evaluate options that have been experimentally designed to control, and if desired exclude, unwanted artefacts of bounded rationality. The information acceleration application here was able to control for such features, allowing the clear observation of decision-making.

In sum, the empirical application shows how information acceleration can contribute to our understanding of IS. The DCE was able to provide measurement of the decision model used to select an IT service strategy. Results showed that managers who did not receive the information acceleration systematically discounted the benefits of the research attributes. The information acceleration allowed uncertainties to be addressed, strengthening the ability to observe the compensatory decision model utilised by the managers.

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