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A technological, organisational, and environmental analysis of decision making methodologies and satisfaction in the context of IT induced business transformations

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Abstract

Although Operational Research (OR) has successfully provided many methodologies to address complex decision problems, in particular based on the rationality principle, there has been too little discussion regarding their limited consideration in IT evaluation practice and associated decision making satisfaction levels in an organisational context. The aim of this paper is to address these issues through providing a current account of diffusion and infusion of OR methodologies in IT decision making practice, and by analysing factors affecting decision making satisfaction from a Technological, Organisational, and Environmental (TOE) framework in the context of IT induced business transformations. We developed a structural equation model and conducted an empirical survey, which supported four out of five developed research hypotheses. Our results show that while Decision Support Systems (DSS), holistic IT evaluation methods, and management support seem to positively affect individual satisfaction, legislative regulation has an adverse effect. Results also revealed a persistent methodology diffusion and infusion gap. The paper discusses implications in each of these aspects and presents opportunities for future work.

Keywords: Decision Analysis; Decision Satisfaction; TOE Framework; Decision making methods; Decision Support Systems; Structural Equation Modelling

1. Introduction

This study considers investment appraisals in the context of IT induced business transformations, such as organisation wide information system projects, where evaluation methodologies from OR need to align well with regulations and managerial prescriptions to satisfy the goals of human decision makers. The aim of the paper is twofold:

1. To emphasise that Operational Research (OR) as a formal science and source of IT evaluation methodologies includes the use of these methodologies by human decision makers in organisations.
2. To appreciate the combination of technological, organisational, and environmental contexts that impact decision makers' satisfaction and consequential behaviour in IT evaluation.

The first point has become a major research aim in OR linked with many interdisciplinary results combing psychology, neuro-biology, and computer science in human decision making, in particular in the organisational context (Barthélemy, Bisdorff, & Coppin, 2002). New challenges in OR are in particular focused on connections between theories and practices to better support the human activities in decision making (Matos, 2007), help reason about methods (Tsoukiàs, 2008), help humans understand methods through Decision Support Systems (DSS) (Vaidya & Kumar, 2006) and find good method mixes (Howick & Ackermann, 2011). This seems to be warranted when considering the sustained gaps between academic theories, commercially available methodologies and actual evaluation practice within organisations (Smithson & Serafeimidis, 2003). A lacking IT evaluation capacity was seen as the "weak link" in the IT investment project (Gunasekaran, Ngai, & McGaughey, 2006). Hence, the steady inflow of new methodologies has so far not provided the intended impact on organisational IT evaluation practice, where many IT/IS decisions are associated with significant business re-organisations. Relating to our second aim, a combination of various technological, organisational, and environmental contexts seems crucial to understand satisfaction and to identify reasons for application gaps differing between active and passive knowledge. While the infusion of methodologies is an expression for the degree of their usage in organisations, diffusion in our context refers to knowing regardless of whether the methodology is used or not (Eder & Igbaria, 2001). A research agenda for DSS consequently mentions the need for more efforts to promote active use, therefore infusion, of methodologies (Shim, et al., 2002). For this to be effective we first need to know to what extent methods are known (diffusion) and used (infusion), and which features contribute to IT decision making satisfaction. Do decision aids, such as method and framework support, a decision support system, or management support increase decision making satisfaction? Additionally, the current economic crisis justifies more attention regarding international legislation and its impact on organisational decision making. Our study seeks to contribute to the problem of ill-advised IT decision making by focusing on these questions and new perspectives on method use, organisational support, and regulation from different perspectives within one model. As a theoretical underpinning, we chose the widely accepted and comprehensive Technology, Organisation and Environment (TOE) framework (Tornatzky & Fleischer, 1990). We draw on ideas from each of its three contexts to pinpoint theoretical predictions stemming from method related aspects to guide our analysis and consider choice of methods, their implementation in DSS, understanding and support by management, and regulation and standardisation issues. As we intend to link method application with human behaviour, we deliberately based this research effort on perceptional measures in an empirical survey. Our research method therefore is nominalist in ontology and positivistic in epistemology (Siau & Rossi, 2011). Through nominalism we assumed that reality is not given but is socially constructed. Our positivist stance implies that we can observe "truth" and test our theoretical predictions with the empirical study of Austrian organisations, which we tested for validity and reliability. As statistical method we applied Structural Equation Modelling (SEM) as this technique fits to our positivist epistemological belief, and supports the causal modelling of the proposed dimensions supported by multiple measures (Chin, 1998). We implemented SEM with the software application SmartPLS based on variance-based Partial Least Squares (PLS) path modelling (Ringle, Wende, & Will, 2005), which is suitable for prediction-oriented research, and has less stringent assumptions than other co-variance based SEM methods (Henseler, Ringle, & Sinkovics, 2009).

The rest of this paper is organized into five sections. In Section 2, we discuss the theoretical base of this paper and pinpoint various elements, which may be relevant for IT evaluation success. In Section 3, we consolidate the literature review and propose a research framework and five research hypotheses. In Section 4, the research methodology is introduced. This is followed by Section 5 presenting our empirical findings, in particular the diffusion-infusion rates of methods and insights from the analytical model. In Section 6, we discuss the findings and implications, and Section 7 concludes the article.

2. Literature Review

2.1. Technology, Organisation, and Environment (TOE) Framework

At the outset of any organisational innovation and learning process human decision making (DM) triggers the reconfiguration and transformation of the organisation. Therefore, decision making was rightfully placed into the core of contemporary dynamic capability theories (Butler & Murphy, 2008; Zahra & George, 2002). IT has long been recognised as the current central enabler to transform business routines. Popular examples include IT transformation of supply chain capacities (Lai, Wong, & Cheng, 2008) or investments in Enterprise Resource Planning (ERP) (Bernroider & Koch, 2001). In recent years assessment complexity has further intensified in IT due to legislative requirements, where the obligatory use of standardized decision support processes and the enforcement of the regulation may impact decision making behaviour (Kevin Zhu, Kraemer, Xu, & Dedrick, 2004). To understand this very broad context we reviewed the literature following both the constraints and opportunities for technological innovation decision making influenced by the three contexts of the technological, organisational, and environmental (TOE) framework (Tornatzky & Fleischer, 1990). The main benefits of the according firm-level TOE framework are its comprehensible structure, sound theoretical basis and its wide recognition and usage by literature (Chau & Tam, 1997; Kuan & Chau, 2001; Kevin Zhu, et al., 2004). The framework posits that a firm's decision to adopt an innovation is dependent on factors from three contextual categories: technology, organisation, and environment. The *technological context* may include technologies, processes, techniques, and equipment in use by or of interest to the company. *Organisational context* is concerned with organisational attributes of the company, such as managerial styles, leadership and governance, human resources, and degrees of formalisation. *Environmental context* deals with the external industrial and governmental factors, as well as with competition and regulation (Tornatzky & Fleischer, 1990). All three contexts are known to influence a firm’s decision process, i.e., its intent to adopt an innovation, its assimilation process and eventually business value creation (Kevin Zhu, Kraemer, & Xu, 2003; Kevin Zhu, et al., 2004). We now move on to a concise review of each model context against the backdrop of evaluating IT induced business transformations. Identified elements within each context were used in the development of the research instrument.

2.2. Technological Context

We have established that the technological context of the TOE framework may include equipment, processes, and techniques (Tornatzky & Fleischer, 1990). Applied to this study we consequently related these dimensions to the level of IT, process and method support in IT evaluation. According to recent literature, we can distinguish between decision methods to quantify diverse potential impacts, and frameworks to guide the process, give structure and integrate methods (Bernroider, Koch, & Stix, 2010). A DSS, here seen as a technology equipment, may integrate both, and thereby provide added value to the decision maker (Karacapilidis & Pappis, 1997). These elements within the technical context determine the analytical capacity of firms to evaluate and interpret the collected information, and combine and create new knowledge (Murphy & Simon, 2002; Wei, Chien, & Wang, 2005). The methods used in IT decision making can be broadly divided into two broad streams: financial and non-financial based approaches (Davern & Wilkin, 2010). Standard financial accounting methods are used mainly to support financial analysis of costs and benefits. The non-financial stream seeks to be more inclusive, such as ranking and scoring techniques, which can include a wider range of measures often consider subjective and perceptual views (Bernroider & Stix, 2006; Saaty, 1980). Many procedural frameworks have a rational root and re-visit the classic "intelligence", "design" and "choice" phases (Simon, 1960). Research in OR and Information Systems has summarised the steady inflow of methods and their enhancements in substantial review papers (Behzadian, Kazemzadeh, Albadvi, & Aghdasi, 2010; Farbey, Land, & Targett, 1993; Gunasekaran, et al., 2006; Smithson & Serafeimidis, 2003; Vaidya & Kumar, 2006). These methods grounded on decision theory with formal guidelines offer a rational and more normative approach to assess and manage the complex evaluation problem, but it is well known that normative views and descriptive perspectives of human behaviour in decision making do not always coincide (Stanovich & West, 1999). Human decision makers may address their bounded rationality with DSS, which attempt to hide the complexity of decisions by using information systems and combining information, methods and frameworks (Arnott & Pervan, 2005). Contemporary DSS may address ecological rationality through adapting to the cognitive needs of the decision maker (Todd, 2007; Todd & Gigerenzer, 2000) or incremental formalisation (Mackenzie, et al., 2006).

2.3. Organisational Context

We noted that the organisational context is potentially concerned with the endogenous organisational attributes of the company (Tornatzky & Fleischer, 1990). Applied to this study we were interested in potentially important governance and management aspects in the application of decision making methods. Governance and management support in decision making and human resource development can support technology sourcing, knowledge management and organisational learning, which in turn may provide competitive advantage (Park, Suh, & Yang, 2007; Siriram & Snaddon, 2004). In the context of IT evaluation, sound IT governance is often cited as the main vehicle to define IT-related authority patterns (Sambamurthy & Zmud, 1999), and to develop a shared understanding of methods and processes, equal responsibilities at board levels, and effective IT strategies (Bowen, Cheung, & Rohde, 2007). These dynamic IT management capacities seem crucial, in particular in transformational IT evaluations, e.g. for ERP projects (Bernroider, 2008; Park, et al., 2007). Support for decision making was suggested as an integral part of the overall company strategy (Kevin Zhu, Kraemer, & Xu, 2006). Also classical views from behavioural science support the notion that the deeper the understanding of normative approaches and methods, the greater the tendency to respond in accord with it (Slovic & Tversky, 1974).

2.4. Environmental Context

We have stated that the environmental context is concerned with exogenous aspects such as governmental regulation and legislation (Tornatzky & Fleischer, 1990). These have become reoccurring research issues in IS research (Kuan & Chau, 2001) and were considered in many different TOE-based studies (Xu, Zhu, & Gibbs, 2004; Kevin Zhu, et al., 2004), where legislative regulation is viewed as the obligatory use of standardized decision support processes and the enforcement of the regulation. In other words, IT control activities are embedded into decision making routines as prescriptive norms to satisfy control and audit requirements imposed by, e.g., the Sarbanes Oxley Act or Basel 2 (Hardy, 2006; Kordel, 2004). Against this backdrop of regulations, these norms or procedural safeguards are mandatory in particular with regard to the transformational IT decisions targeted in this paper.

3. Hypotheses

3.1. Research Model

Based on the previous section we are now able to define the structure of the research model consisting of latent variables from the aforementioned technical, organisational, and environmental contexts. These are the dimensions of the TOE framework we used as a high-level theoretical basis. Figure 1 shows the three contexts, denoted as dotted boxes, and their latent factors - IT Support, Framework Support, Method Support, Management Support, and Legislative Regulation - that impact Decision Making (DM) Satisfaction as the dependent variable. The model gives a combined view on IT evaluation, not only considering identified technical aspects, such as methods and frameworks, but also organisational and environmental ones. Next, we will develop the five hypotheses shown in Figure 1, denoted H1 to H5, by discussing predicted positive or negative impacts of each independent factor, denoted by plusses and minuses, on DM satisfaction as the dependent factor.

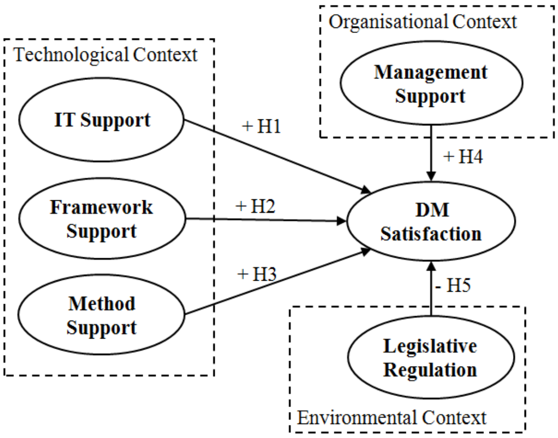

Fig. 1. Research model.

3.2. Hypotheses Development

Early studies have indicated that the use of different forms of DSS, such as executive IS or expert systems, have an impact on the quality of management decisions (Landsbergen, Coursey, & Loveless, 1997; Leidner & Elam, 1995). Not only traditional but also contemporary forms have been investigated. Decision making satisfaction with web based decision support is dependent on the quality of systems and the information supplied (Bharati & Chaudhury, 2004). Multi-criteria approaches, such as the Analytical Hierarchy Process (Saaty, 1980) or ELECTRE, an acronym for elimination and choice expressing reality (Mousseau, Figueira, & Naux, 2001; Roy, 1978), have existed for decades, but only their embedment in user-friendly DSS promises infusion into different application environments (Chris & Alessio, 2010). We therefore assume that

H1. IT support is positively associated with IT decision making satisfaction.

Research has acknowledged the need for IT evaluation framework building (Björnsson & Lundegård, 1992) and recommends to use and to develop more advanced, or combined instruments that take into account multi-criteria, multi-stakeholder, and systemic streams of OR (Kunsch, Kavathatzopoulos, & Rauschmayer, 2009). Different researchers and practitioners develop frameworks to guide decision makers through the process (Reiner & Stix, 2004; Remenyi, 1999). Recent attempts at framework building try to access and combine diverse methods in OR and strive to integrate people, information and technologies (Bernroider, et al., 2010) or guide the decision maker through the evaluation process and parameter selection (Joshi & Pant, 2008). A multiple case study reported that the quality of large-scale IT investment decisions with long-term effects should be determined by the use of a holistic and rational decision process approach based on different decision stages (Reiner & Stix, 2006). This study concluded with a prescriptive process framework following the logic of alternative generation, evaluation, and decision-making. This structure is similar to the original work proposed by Simon (1960) with an "intelligence", "design", and "choice" phase. From an investigation into loan risk assessment, decision frameworks support standardisation and decision criteria specification, which seems to lead to more assessment stability and consequently benefits the organisation (Sutcliffe & McNamara, 2001). We therefore assume that

H2. Framework adoption is positively associated with IT decision making satisfaction.

An IT project needs to be categorised and supported with the a method so objectives and associated costs and benefits can be understood (Ross & Beath, 2002). Ease of use of methods is an important aspect of method diffusion and is a well acknowledged predictor in the Technology Acceptance model (Davis, 1989), which is probably the most used behavioural IT acceptance model in IS research (Chen & Hirschheim, 2004). IS research has stressed the decision maker's aversion to effort (Benbasat & Todd, 1992), which also supports that an easy to use method will provide better results, either by improving decision effectiveness with the same effort or by providing time and therefore cost savings at the same level of decision effectiveness. The ability to evaluate and assess IT investments should allow firms to better understand organisational benefits and incompatibilities to address implications and gain performance improvements from the investment (Gunasekaran, et al., 2006). Hence, we assume that

H3. Method support is positively associated with IT decision making satisfaction.

Management support is regular seen as a critical important success factor in organisational projects (The-Standish-Group, 2009; Wixom & Watson, 2001). Management support is for example needed for effective ERP adoption (Bernroider, 2008) and Data Warehouse (DW) success (Wixom & Watson, 2001). Of importance in the latter study is the concept of widespread management support replacing a single operational sponsor. More effective governance of IT investments seems to be dependent on management involving the development of a shared understanding of goals, active involvement of stakeholders, balance of decision rights, and communication (Bowen, et al., 2007). Research data reinforces the necessity of top management commitment in IT projects (Sohal & Fitzpatrick, 2002). While there is abundant empirical evidence on the importance of management support for the IT project as a whole, the literature lacks equal consideration of the role of management support in decision making in the pre-implementation stage of an IT project. We assume that

H4. Management support is positively associated with IT decision making satisfaction.

Many IT adoption studies see positive impacts of a strong regulatory environment especially in less developed countries (K. Zhu, Xu, & Dedrick, 2003), e.g. increased trustworthiness. However, negative aspects were also found such as increased complexity of decisions and higher costs in implementing compliance issues (El-Kharbili, Markovic, Pulvermüller, & Stein, 2008). We do not seek to answer the question whether compliance costs outweigh any organisational benefits, but focus on decision making satisfaction on the individual level. Considering the evidence for additional time and training needed for compliant decision making, we therefore hypothesize that

H5. Legislative regulation is negatively associated with IT decision making satisfaction.

4. Research Methodology

4.1. Survey Approach

This study uses data from practical experiences with evaluating IT transformations in organisations. The sampling frame for the empirical survey consisted of 850 randomly selected companies from the industry-independent target population defined as all enterprises in Austria with a reported last known year's balance sheet total of over € 5 million. We extracted the respective target population from the widely used and comprehensive Amadeus Database containing financial information on public and private companies across European countries (Bureau-van-Dijk, 2009) and associated unique IDs to each company. A random number generator was used to select the desired 850 unique IDs, which we used to lookup the addresses, and thereby arrive at a simple random sample. As this procedure ensured that each subset of firms had the same probability of being chosen for the sample as any other subset of firms, we can assume a good level of representation of the entire population. The questionnaire was administered in a multi-staged procedure to "IT-decision makers or a person that has decision making authority concerning IT-investments", which is a statement included in our prelude. Additionally, our prelude included an explanation about our focus on transformational IT projects with illustrative examples. All companies were initially contacted by telephone. Only those interested received an email invitation for participation. This procedure was necessary to comply with the Austrian telecommunication law on bulk-Emails prohibiting invitations to more than 50 companies per email. As an incentive we offered the study results, information on IT decision making methods and case study collaboration.

4.2. Return Quota and Response Bias

In our fieldwork we were able to reach 787 companies by telephone. While many instantly rejected to participate and were consequently classified as "non-respondents", others allowed us to send an email giving access to an online questionnaire. Some agreed spontaneously to take part in an ad-hoc interview. The process took ten full person days and concluded with 114 completed questionnaires corresponding to a net return quota of 14.5% considering neutral dropouts (63 companies). Neutral dropouts do not decrease the return quota and refer to companies that could not be contacted as they ceased to exist, closed their business or could not be found due to an incorrect address. Out of our initial simple random sample, we were able to identify 406 companies as non-respondents and 444 companies as potential respondents including the above mentioned 114 returns. Due to our promise to treat returned datasets anonymously, we could only accurately identify the 406 instant non-respondents. The comparison between those two groups revealed no significantly different characteristics ($p>.42$ in all cases) in terms of the number of employees, operating revenue, and total assets as measured by two-sample unpaired t tests. As the differences between two means for each group are not statistically significantly different from zero for all three considered characteristics, we see no evidence for response-bias. This approach to non-response analysis can be more accurate than wave analysis to assess non-response bias in surveys (Van der Stede, Mark Young, & Xiaoling Chen, 2006), where early versus late respondents are compared on the assumption that late respondents more likely resemble non-respondents. Related research suggests that different rates of return do not come with different profiles of respondents (Lankford, Buxton, Hetzler, & Little, 1995). Using late respondents as a proxy group for non-respondents can therefore be challenged. In our approach, we have used an accurate list of non-respondents from a random sample, but had to accept imprecision regarding the group of respondents.

4.3. Pre-testing Procedure

We optimised the questionnaire with three rounds of iterative pre-testing, each followed by an academic review of issues resulting in further changes to the wording and structure of the instrument. The first two rounds of pre-testing were undertaken by two groups of eight people, composed of undergraduate students and graduates with an Information Systems background. Professional occupation of participants included IT and management roles. In the third round of pre-testing the instrument was administered to three practitioners in the IS area only. Pre-test recommendations included changes to the industry classification, orientation of the scales, shortening of lengthy questions and texts and wording related issues.

4.4. Operationalisation of Variables

We relied on the prior literature to design our research questionnaire and operationalise the variables in our research model (see Appendix A1). Within the technological context, we used the three identified dimensions of methods - levels of IT support measured by DSS use and integration, framework adoption measured by decision process support, and method support measured by their incorporation of main types of metrics - as central elements in the technological context of IT decision making. Management support within the organisational context was measured by considering possible aspects of organisational prescriptions for IT decision making: policies and rules; knowledge about decision making methodologies; clear authority patterns; and guiding strategic objectives. Within the environmental context, we referred to the scope of legislative regulation and the enforcement of compliance to comply as proxies. Regarding measuring the dependent variable, decision making satisfaction, there is no consensus in the literature. Some have measured satisfaction as user information satisfaction (Ives, Olson, & Baroudi, 1983), satisfaction with decision confidence and decision effectiveness (Bharati & Chaudhury, 2004), or satisfaction with ease of use or outcome benefits (Doll, Deng, Raghunathan, Torkzadeh, & Xia, 2004). The latter study also states that satisfaction measurements are context sensitive. We decided to combine different views in a four-item reflective construct.

Respondents were asked to assess the given questions on different scales, either on dichotomous scales (yes=1, no=0), on metric scales (e.g., for the number of employees), or on interval scales (either percentages from 0 to 100%, or 7-point interval scales). For measuring satisfaction, literature recommends the use of disconfirmation scales to see the discrepancies between ex-ante expectations and ex-post performance as proxy for satisfaction (Negash, Ryan, & Igbaria, 2003). Disconfirmation can either exist in a positive or negative way, and by that lead to satisfaction or dissatisfaction (Churchhill & Surprenant, 1982). The measurement scales for assessing customer satisfaction seem to support discriminant and convergent validity, and lessen the asymmetry of responses (Negash, et al., 2003). We therefore used 7-level Likert items based on perceptions measured against expectations ranging from 1 (strongly disagree) to 7 (strongly agree), which we considered as interval-level data.

To summarise, Table 1 denotes the five independent latent variables as formative constructs and one dependent latent variable as reflective construct with their main supporting references and their question codes. For the full question wordings see Appendix A1.

Table 1
Latent variables and their indicators.

Contexts and latent variables	Operationalisation	Code	Main literature support
Technology			
IT support	Decision support system in place	IT01	(Landsbergen, et al., 1997; Leidner & Elam, 1995; Kevin Zhu, et al., 2003)
	Decision support system is easy to use	IT02_01	
	Integration with internal databases and IS	IT02_02	
Framework support	Standardised framework in place	FW01	(Bernroider, et al., 2010; Reiner & Stix, 2006)
	Support of "Intelligence" phase	FW02_01	
	Support of "Design" phase	FW02_02	
	Support of "Choice" phase	FW02_03	
Method support	Decision support methods in use are easy to handle.	ME02_01	(Renkema & Berghout, 1997; Ross & Beath, 2002)
	Decision support methods in use rely on a variety of financial key-figures.	ME02_02	
	Decision support methods in use rely on a variety of non-financial key-figures.	ME02_03	
	Decision support methods in use consider a variety of strategic implications.	ME02_04	
Organisation			
Management support	IT decision support rules are an integral part of overall company strategy	MA05_01	(Bernroider, 2008; Bowen, et al., 2007; Kevin Zhu, et al., 2003, 2006)
	Knowledge/skills of employees concerning IT decision support methods	MA05_02	
	IT decision competencies are clearly defined	MA05_03	
	No change in goals and requirements during IT decision process.	MA05_04	
Environment			
Legislative regulation	Obligatory use of standardized decision support process' by legislation	MA05_05	(Chau & Tam, 1997; Xu, et al., 2004; Kevin Zhu, et al., 2004)
	Enforcement of compliance with legislative regulations	MA05_06	
Dependent construct (ξ)			
DM satisfaction	Perceived decision confidence	SA05_01	(Bharati & Chaudhury, 2004; Doll, et al., 2004; Ives, et al., 1983)
	Perceived ease of decision taking	SA05_02	
	Perceived satisfaction with decision	SA05_03	
	Perceived decision effectiveness	SA05_04	

4.5. Common Method Bias

This research paper is based on a single method to assess all constructs with self-report questionnaire data. A common concern with such approaches is single method bias or common method variance (CMV) (Malhotra, Kim, & Patil, 2006), which refers to the amount of covariance shared among indicators due to mono-method research designs. To address this issue, we applied Harman's single-factor test. This diagnostic technique requires loading all the variables in a study into an exploratory factor analysis, with the assumption that the presence of CMV is shown by the emergence of either a single factor or a general factor accounting for the majority of covariance among measures (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). We conducted the Harman's one-factor test by entering all the item of instrument into a principal components factor analysis (Podsakoff & Organ, 1986). Twenty-two factors resulted. The first accounted for 22.5% of the variance. The other twenty-one (with eigenvalues greater than one) contributed to 83% of the variance explained by the whole set each accounting for 1%–8%. This suggests that while there is likely to be some CMV, the effect is small.

4.6. Statistical Measurement Tool

Besides calculating descriptive statistics, the main statistical method applied in this study is a structural equation modelling (SEM). SEM was needed for testing our theoretical predictions in a combined analysis of the measurement and structural model. It addresses unreliability directly by using multiple indicators of each construct in a causal model (Baron & Kenny, 1986). Our latent variables were therefore regarded as directly unobservable, and assumed to manifest themselves through indicator variables. In relation to pure manifested modelling, this multiple indicator approach is known to better capture the richness of a problem (B. Lee, Barua, & Whinston, 1997). SEM has been used extensively for validating instruments and testing linkages between constructs in other positivist empirical papers in OR and IS (e.g. Bharati & Chaudhury, 2004; Park, et al., 2007; Su & Yang, 2010). We applied the variance-based PLS (partial least squares) modelling approach, which origins date back to 1966 (Chin, 1998). As an alternative to covariance based SEM approaches, Wold proposed PLS as softer modelling approach with fewer stringent requirements regarding distributions properties, i.e. multivariate normality of data and large samples (Wold, 1982). Its overall objective is to reject a set of path-specific null hypotheses of no effect and supports the use of our formative and reflective latent variables (L. Lee, Petter, Fayard, & Robinson, 2011). We used the freely available software package SmartPLS (Ringle, et al., 2005). The significance of all model paths was tested with the bootstrap re-sampling procedure (Gefen, Straub, & Boudreau, 2000).

5. Data Analysis and Validity

5.1. Sample Demographics

The industry sector classification of the survey respondents is based on the NACE ("Nomenclature générale des activités économiques dans les Communautés européenne"), the Statistical Classification of Economic Activities in the European Community (EC, 2008). An aggregation of the industry sectors to 4 groups leads to a distribution of 26% of the respondents in general sectors including the main contributor manufacturing, 9% in commerce/trade, 54% in services and 11% in public administration (see Table 2).

Table 2
Distribution of sample firms by industry.

Sector (%)	Sector	No. of organisations	% of organisations
General (26)	Agriculture	2	1.8
	Mining	2	1.8
	Manufacturing	21	19.0
	Building & construction	4	3.6
Commerce / Trade (9)	Commerce / Trade	10	9.0
Services (54)	Energy	5	4.5
	Utility (excl. Energy)	1	.9
	Hotels & restaurants	3	2.7
	Transportation	5	4.5
	Information & telecommunication	16	14.4
	Financial services	14	12.6
	Housing	6	5.4
	Various	5	4.5
	Art & education	5	4.5
Public admin. (11)	Public administration	5	4.5
	Education	3	2.70
	Healthcare & social	3	2.70
	Extraterritorial organisations	1	.9
	Total	111	100
	Unknown sector	3	
	Total sample size (N)	114	

5.2. Diffusion and Infusion of Decision Making Methods

Based on the taxonomic review provided by literature (Reiner & Stix, 2006; Renkema & Berghout, 1997), we clustered a total of twenty one decision support methods into four different groups shown in Table 3. The *financial category* consists of standard investment analysis methods, such as discounted cash-flow (DCF) calculations and Return on Investment (ROI) considerations, which can also be classified as ratio-methods according to one of the taxonomies used (Renkema & Berghout, 1997). Some methods can be attributed to different classes of methods, such as the Balanced Scorecard (BSC) approach that could be classified as a multi-criteria approach as well as a strategic method. *Multi-criteria methods* are based on multiple pre-defined multiple criteria through which a finite set of alternative are assessed to arrive at a preference decision (e.g. evaluation, prioritization, selection) (Yoon & Hwang, 1995). In an IT context the criteria are often tailored to IT decisions, e.g. through the Information Economics (IE) approach (Parker & Benson, 1988). The *strategic category* relies on methods that are useful for long-term planning without the necessity to assess short term impacts, e.g. scenario techniques (ST) or SWOT based analyses. The *fourth category of portfolio methods* supports placing investment projects or already existing IT-services into a multi-segment graphical representation. A comparison of diffusion and infusion of methods along the previously defined classes of methods reveals a gap between knowledge of decision makers and actual usage in practice. While standard financial investment methods are not only highest ranking in diffusion (89.5%), they also have a comparably high rate of infusion (74.6%). While multi-criteria methods are better known than strategic or analytical techniques, 71.9% compared to 63.2%, the infusion rates in Austrian companies are low with 33.3% compared to 42.1%, respectively. In addition, except for the Balanced Scorecard (BSC, 23.7%) and to a lesser extent the Utility Ranking Method (URM, 15.8%), hardly any other multi-criteria approach is used. The infusion of portfolio methods (11.4%) also suffers from a low rate of diffusion (36.8%). For more information on the individual methods more supporting literature was cited (e.g. Renkema & Berghout, 1997).

Table 3

Diffusion (known) and infusion (used) of methods from primary survey data.

IT appraisal method	Diffusion (%)	Infusion (%)
Financial investment methods (at least one)	*89.5*	*74.6*
Payback period (PP)	71.1	46.5
Return on Investment (ROI)	63.2	44.7
Disc. cash flow (DCF) or Net present value (NPV)	62.3	37.7
Cost/Benefit (CB)	60.5	43.9
Total Cost of Ownership (TCO)	57.0	33.3
Internal Rate of Return (IRR)	47.4	17.5
Real Options (RO)	17.5	1.8
Multi-criteria methods (at least one)	*71.9*	*33.3*
Balanced Scorecard (BSC)	58.8	23.7
Utility Ranking Method (URM)	53.5	15.8
Analytic Hierarchy Process (AHP)	21.1	5.3
Information Economics (IE)	16.7	3.5
SIESTA method	5.3	1.8
Kobler Unit Framework (KUF)	2.6	.9
Strategic and analytical techniques (at least one)	*63.2*	*42.1*
Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis	57.9	36.0
Decision Trees (DT)	50.0	16.7
Critical Success Factors (CSF)	40.4	23.7
Scenario Technique (ST)	37.7	23.7
Return on Management (ROM)	18.4	.9
Portfolio methods (at least one)	*36.8*	*11.4*
Investment Portfolio (IP)	28.1	6.1
Investment Mapping (IM)	20.2	5.3
Bedell's method (BM)	12.3	2.6

5.3. Measurement Validation

As suggested in Section 4.6 the construct was calculated using the Partial Least Squares (PLS) procedure (Wold, 1982) with the SmartPLS software (Ringle, et al., 2005). Missing values were imputed with mean values during the process of model estimation. After the simultaneous calculation of the measurement and structural model, we firstly turn our attention to the construct validity, which needs to be considered separately for the reflective and formative constructs (L. Lee, et al., 2011). For valid construct validity, we first considered reliability and discriminant validity for the only reflective first-order factor in the model ("Decision making satisfaction"). For adequate reliability (internal consistency) a Cronbach's α above 0.7 is considered acceptable (Nunnally, 1978). This rule can also be applied to composite reliability (Barclay, Higgins, & Thompson, 1995). Table 4 shows that both measures are acceptable for the dependent construct. The inter-relatedness of the scale can be seen by considering the latent variable correlations. In terms of our reflective latent variable ("DM satisfaction"), the square root of its AVE should be greater than its correlation with other latent variables. In our case this holds true for a square root of the AVE of the respective scale (0.84). Therefore, the items measuring the construct are more closely associated with its intended construct than with any other, which supports discriminant validity (Fornell & Larcker, 1981). In addition, the squared root of the AVE by a construct from its indicators should be at least 0.7 and an AVE of more than 0.5 means that 50% or more variance of the indicators is accounted for. The respective values of 0.84 and 0.70 with regard to the calculated satisfaction factor are well above both thresholds. Further adding to construct validity is the consideration of item loadings, which ideally should be greater than 0.7, again indicating that 50% or more variance of the indicators is captured by the construct (Chin, 1998). In our case, the loading of one item (SA05_02) was high, but below the threshold at 0.59. Consequently, the item was dropped and the model recalculated, which should have no impact on the content validity of the research model due to the reflective nature of the construct. The same reliability considerations do not apply to formative constructs as their indicators are capturing different dimensions of the construct, which do not necessarily need to be correlated (L. Lee, et al., 2011). For this reason we seek to retain the full variance of each item and not just the shared variance. Table 4 also reports on the individual (outer) weights of each item and their respective t-values. As recommended, we used bootstrapping with 500 subsamples as a non-parametric re-sampling procedure to test the statistical significance of the results using t-tests (Chin, 1998). These t-tests are not calculated as part of the PLS algorithm. Table 4 shows the t-tests and the significance levels for each of the item loadings. We followed the suggestion to retain the non-significant items to preserve content validity (Bollen & Lennox, 1991; Petter, Straub, & Rai, 2007) and to consider the implications in the interpretation of results. Variance inflation indicators (VIF) were calculated to determine the level of multicollinearity among indicators. Multicollinearity could cause non-significant weights and problems with the interpretation of the results, e.g., in terms of which items have more or less influence. In regression, a VIF > 10 is frequently used as an indication of a problematic level of multicollinearity. However, every level of VIF substantially greater than one in principle indicates multicollinearity (Henseler, et al., 2009). In our case, we observed problematic levels of multicollinearity among the indicators of framework support and IT support.

Table 4
Measurement model validity and latent variable correlations

Dependent Construct (reflective)	Loadings	AVE	SQRT (AVE)	Cronbach's α	Composite reliability	R^2
Decision making satisfaction		0.70	0.84	0.79	0.88	0.47
SA05_01	0.75					
SA05_02	dropped*					
SA05_03	0.91					
SA05_04	0.85					
Independent Constructs (formative)	**Weights**	**t-values**	**Significance**	**VIF**		
IT support						
IT01	0.62	2.47	p<0.05	7.87		
IT02_01	0.49	1.99	p<0.05	17.55		
IT02_02	0.40	1.11	/	16.94		
Framework support						
FW01	0.71	1.20	/	6.81		
FW02_01	0.01	0.01	/	11.00		
FW02_02	0.65	3.00	p<0.01	17.72		
FW02_03	0.16	0.75	/	10.44		
Method support						
ME02_01	0.15	1.41	/	1.75		
ME02_02	0.47	3.24	p<0.01	1.98		
ME02_03	0.30	1.64	p<0.10	3.13		
ME02_04	0.56	3.13	p<0.01	3.43		
Management support						
MA05_01	0.36	1.72	p<0.10	2.79		
MA05_02	0.48	2.45	p<0.05	2.77		
MA05_03	0.11	0.90	/	1.72		
MA05_04	0.35	2.69	p<0.01	1.68		
Legislative regulation						
MA05_05	0.47	0.98	/	3.92		
MA05_06	0.58	1.03	/	3.92		
Latent variable correlations	**Framework support**	**IT support**	**Legislative regulation**	**Management support**	**Method support**	**DM satisfaction**
Framework support	1					
IT support	0.32	1				
Legislative regulation	0.41	0.22	1			
Management support	0.42	0.21	0.50	1		
Method support	0.21	0.17	0.31	0.50	1	
Decision making satisfaction	0.28	0.24	0.19	0.59	0.55	1

* Initial loading of 0.59 (below the threshold of 0.7)

Finally, we turn to assessing the whole model. The model explains a proportion of 48% (R^2) of the variance in decision making satisfaction as our dependent latent variable. As a guideline, an R^2 of the dependent latent variable higher than 0.33 can be seen as moderate (Chin, 1998). Another source states that an R^2 greater or equal than 0.1 ensures that the variance explained by the independent variables has practical and statistical significance (Barclay, et al., 1995). Another source cites a required cut-off criterion of 0.4 (Homburg & Baumgartner, 1995). Hence, the given value of 0.48 indicates a satisfying level of predictability.

5.4. Structural Model Evaluation

The purpose of the structural equation model was to test the specified research hypotheses in order to examine the influence of five latent constructs drawn from the background of the TOE-framework on decision making satisfaction. Again, we used the results from bootstrapping with 500 subsamples as a non-parametric re-sampling procedure to calculate t-statistics and standard errors (Chin, 1998). Additionally, for each effect in the structural mode an effect size (f^2) can be evaluated (Cohen, 1988). The effect size f^2 of a latent factor results from analysing the decrease in R^2 when excluding one independent latent factor. It was suggested that f^2 values of .02, .15, and .35 mean small, medium, and large effects, respectively. Table 5 shows the hypothesized relationships, effect sizes, standardized coefficients including their respective standard errors and t-values.

The *technological context* within the combined TOE framework posits factors impacting positively on decision satisfaction are related to IT support, framework support and method support. Within this context the results indicate that method support has the most significant and strongest positive relationship with decision making satisfaction (medium effect, $\beta = .35$, $p < .01$). By considering the underlying variables of the formative construct, we see that the inclusion of a variety of dimensions (financial, non-financial, strategic) seems to increase decision making satisfaction levels. To a much smaller extent IT support seems to be positively related with decision making satisfaction (weak effect, $\beta = .11$, $p < .05$). In this relationship, ease of use of an existing decision support system is most important. We assumed a positive contribution from the use of a standardized process following a framework approach to satisfaction levels. The latent factor is mainly characterised by the support of the design phase in the decision making process. However, the data did not allow us to give any verdict in regard to framework support and its impact on decision making satisfaction.

In the *organisational context* we assumed that managerial support in IT evaluation is positively associated with decision making satisfaction. The respective hypothesis is supported by the strongest path dependency of all hypothesised relationships (medium effect, $\beta = .47$, $p < .01$). The independent constructs mainly reflects the skills of employees regarding decision making methods, the management of respective capabilities and the stable definition of decision making requirements. All of these IT governance and knowledge management aspects seem to be important drivers of decision making satisfaction.

Relating to the *environmental context*, we were concerned that legislative regulation could be negatively associated with decision making satisfaction. While this relationship is indeed indicated by the data (weak effect, $\beta = -.20$, $p < .05$), the underlying causal variables of the respective latent formative factor do not have significant weights. This must be noted as limitation.

Table 5
Verdict on structural relationships.

Path (Hypothesis)	Effect size (f^2)	Path co-efficient (β)	Standard error	t value	Verdict
Technological context					
IT-support → DM satisfaction (+ H1)	.02	.11	.05	2.28*	Weakly supported
Framework support → DM satisfaction(+ H2)	.00	.05	.06	.93	Not supported
Method support → DM satisfaction (+ H3)	.17	.35	.08	4.56**	Supported
Organisational context					
Management support → DM satisfaction (+ H4)	.23	.47	.11	4.42**	Supported
Environmental context					
Legislative regulation → DM satisfaction (- H5)	.05	-.20	.08	2.52*	Weakly supported

* $p < .05$; ** $p < .01$

6. Discussion

This research informs IT evaluation both on a practice level and a theory level. Returning to the original aims of the paper, our first main finding shows that many human decision makers in organisational IT evaluation practice seem not to rely on the methodologies needed to exhaustively capture the complex IT evaluation problem. A wide gap between recent theory on IS evaluation methods and their practical implementation seems to remain (Smithson & Serafeimidis, 2003). This problem challenges the classical unbounded rationality principle in OR and decision making (Barthélemy, et al., 2002; Todd, 2007) and supports accepting the interdisciplinary nature of decisions observed through their practice (Tsoukiàs, 2008). Our findings show that in practice, decision making methodologies are becoming more known but lack actual usage. Compared to an Austrian ERP decision study from about a decade ago the levels of infusion (used methods) have not increased (Bernroider & Koch, 2001). Apart from standard financial investment tools, a significant methodology diffusion-infusion gap remains. This finding implies that many known methodologies are not accepted in practice while many other seem not to diffuse into practice in the first place. As acceptance is inherently linked with satisfaction, our second main contribution addresses the second initially stated research aim and relates to the analysis of the contextual factors potentially impacting on IT decision making satisfaction viewed through the theoretical lens of the TOE framework (Tornatzky & Fleischer, 1990). In the technological context of the TOE framework, methods incorporating a variety of financial, non-financial, and strategic aspects implemented in a easy to use DSS positively affect decision making satisfaction. We thereby add to previous findings about the general value of a IT system's ease-of use in IT acceptance behaviour (Davis, 1989) and, more specifically, the importance of DSS for decision making satisfaction (Bharati & Chaudhury, 2004). We support the call for more use of DSS to address complexities arising out of the integrated models (Vaidya & Kumar, 2006). Especially methods appreciating the whole range of dimensions in decisions should be used as facilitators of IT decision making satisfaction. In the organisational context, management support seems to be an essential driver for satisfaction. While prior research showed that the capacity to assimilate knowledge relates to the understanding the IT artefact (Park, et al., 2007), we relate more directly with the analytical capacity needed to evaluate the artefact. Furthermore, decision makers should be able to establish linkages between objectives and evaluate IT based on a clear authority and competency distribution. These factors connect well with the importance assigned to IT governance (Bernroider, 2008). Another implication is that that management support metrics are viable candidates for early indicators to assess IT adoption performance, e.g. in balanced scorecards (Kaplan & Norton, 1992; Wiersma, 2009). This link is theoretically well supported by the concept of absorptive capacities (Zahra & George, 2002), where management competence is regularly used as one indicator of potential absorptive capacities which includes analytical capabilities (Szulanski, 1996). The environmental context contributes to understanding the impact of regulatory pressure through legislative requirements, which seems to go beyond organisational compliance costs. The data indicates that legislative regulation and associated internal control requirements impact negatively on IT decision making satisfaction.

Taken together our results reveal that increased decision making satisfaction seems to be the sum of many variables, and is not solely achieved by proposing OR methodologies in isolation without supporting mechanisms. Besides incorporating methodologies in integrated DSS as suggested before (Vaidya & Kumar, 2006), it seems important to increase levels of managerial support and understanding while reducing the perceived pressure from regulatory and legal compliance, which would together facilitate acceptance and in turn may close the previously identified diffusion-infusion gap. Theoretically, the classic understanding/acceptance principle from behavioural science gives an explanation why understanding of normative methods facilitates their acceptance (Slovic & Tversky, 1974). This research, however, calls for the consideration of more factors than understanding of methods alone to support a rational evaluation of the IT induced organisational transformation. These factors can be found in the technical, organisational, and environmental contexts of the IT innovation.

7. Conclusions, Limitations and Future research

7.1. Limitations

A common problem in empirical research is reliability. We controlled reliability with the following measures. As a start we used random sampling to ensure a good representation of all targets. Non-response bias analysis did not reveal any evidence of bias. We could not avoid the use of a mono method and single respondent strategy, which however is common in many studies of similar designs (e.g. Fink & Neumann, 2009). Therefore, we controlled the role of the target person and semantically linked questions to the last transformational IT project, which is a more perceivable unit of analysis than all past IT projects in general. The interviewees were IT and general managers, which may have differing views. However, contemporary studies on ERP benefit perceptions report very similar perceptions by IT and general management. This empirical observation was partly explained by the increasing pervasiveness of IT in modern business (Chang, 2006). Concerning the mono-method approach, Harman’s single-factor test did not reveal concerns regarding common method variance (Malhotra, et al., 2006). The multiple pre-tests should have ensured a low rate of measurement error, in particular regarding the inquiry about specific decision making methodologies. However, due to ambiguities and differing naming conventions some imprecision in terms of responses seems likely. Follow on research could extend or revise our research model and also search for third variables either based on moderation or mediation (Baron & Kenny, 1986).

7.2. Conclusions and Future Research

While OR continues to develop and propagate decision making methodologies, the understanding and subsequent acceptance of methodologies in complex IT evaluation through their use in business practice remains very slow-paced. The formality of methods may hinder their application, and only by appreciating complex IT decision making as a human centred process we may improve satisfaction and consequently acceptance of methodologies in a broad organisational context. For this task the paper highlighted current diffusion and infusion rates of methodologies and used the contexts from the TOE framework to understand how satisfaction of IT decision making processes may be developed. Our structural model shows that the comprehensiveness of the supporting method indeed has a positive impact on decision making satisfaction levels, which are also positively affected by management and IT support. Legislative regulation of decision making, however, seems to contribute negatively to satisfaction levels. Results reiterate the importance of knowledge transfer between research and industry practice to further disseminate methods embedded in DSS and compliance directives that make decisions more effective rather than more time consuming. We perceive a lack of research into understanding infusion of methods, and work on promoting and propagating factors that lead to more satisfaction in decision making. The area is wide and other organisational constructs connected with knowledge management and organisational learning, such as analytical absorptive capacity, may be used in future studies to understand antecedents and inhibitors of decision making satisfaction for decision processes. Our findings also suggest that the decision maker may not be tempted to use existing methods based on the classical rationality principle, and may look for alternative approaches. Leaving the traditional view of unbounded rationality behind, future OR could focus more on managing the cognitive demands, e.g. by addressing ecological rationality with various heuristics in easy-to-use DSS designs. Our paper has proposed links between OR and other disciplines through the TOE model. We believe that only by understanding what these other disciplines have to offer, we can eventually increase OR infusion rates in organisational IT decision making.

Appendix

Table A1

Research instrument.

Section	Question	Scale	Scale Format	Code
IT support	A decision support system is used in your organization.	Binary	Yes / No (Filter question for IT02)	IT01
	The decision support system that is used in your organization is …			IT02
	… easy to use.	Interval	(1-7) (strongly disagree / neutral / strongly agree)	_01
	… well integrated with your internal databases and other information systems.			_02
Framework support	A standardized decision support process is deployed in your organization.	Binary	Yes / No (Filter question for FW02)	FW01
	The standardized decision support process in that is deployed in your organization supports the phases of …			FW02
	… problem definition (intelligence).	Interval	(1-7) (strongly disagree / neutral / strongly agree)	_01
	… generation of alternatives (design).			_02
	… choosing among alternatives (choice).			_03
Method support	The decision support methods that are used in your organization are …			ME02
	… easy to use.	Interval	(1-7) (strongly disagree / neutral / strongly agree)	_01
	… rely on a variety of financial key-figures.			_02
	… rely on a variety of non-financial key-figures.			_03
	… consider a variety of strategic implications.			_04
Firm size	Approximately how many employees does your organization have in total, including all branches, divisions and subsidiaries?	Ratio	Number of employees	SI01
Firm scope	Approximately what percent of total sales and procurement spendings are from outside your country?			SC01
	Sales	Ratio	0 – 100%	_01
	Procurement	Ratio	0 – 100%	_02
	Please indicate the geographic extent of your company's operations.	Ordinal	Local Regional Austrian wide European Worldwide	SC02
Management support	When answering these questions, especially think of your last IT-decision. Indicate to which extent you agree with the following statements.			MA05
	Well defined rules for the IT-decision process are integral part of the company's strategy.	Interval	(1-7) (strongly disagree / neutral / strongly agree)	_01
	Decision makers in your organization have extensive knowledge concerning decision support methods.			_02
	IT-decision competencies are clearly defined in your organization.			_03
	The goals and requirements do not change during the IT-decision process.			_04
Legislative regulation	The legislative regulation pledges your organization to use a standardized decision support process.	Interval	(1-7) (strongly disagree / neutral / strongly agree)	_05
	The compliance with the legislative regulations concerning the IT-decision process is enforced strictly.			_06
Competition intensity	The competitive pressure your company faces is significantly harder than in other sectors.	Interval	(1-7) (strongly disagree / neutral / strongly agree)	CO01
Decision making satisfaction	When answering these questions, especially think of your last IT-decision. Indicate to which extent you agree with the following statements.			SA05
	The confidence in the last IT-decision that was taken in your organization is strong.	Inter-val	(1-7) (strongly disagree / neutral / strongly agree)	_01

	Decision taking was easier than expected at the beginning.			_02
	From today’s viewpoint the satisfaction with the decision is higher than expected at the beginning.			_03
	The benefits from the decision are bigger than demanded at the beginning.			_04
Demo-graphics	What is your position in your company?	Nom-inal	Top management (Non IT) Top management in IT Middle management (Non IT) Middle management in IT Other	DE01
	In which sector does your company operate mostly?	Nom-inal	Agriculture Mining Manufacturing Building & Construction Commerce, Trade Energy sector Utility industry (excl. Energy) Hotel & Restaurant industry Transportation Inform. & Telecommunication Financial Services Housing Various services Art & Entertainment Public Administration Education Healthcare & Social Extraterritorial organisations	DE02
	The decision process for the last IT innovation in your organization took …	Ratio	Time to decision in weeks	DE03
Infusion/ diffusion of methods	Which of these decision support methods do you know and which of them are actually used in your organization? Unknown methods simple leave unticked.			
	Multi-criteria methods	Nominal	Analytic Hierarchy Process (AHP) Balanced Scorecard Information Economics Kobler Unit Framework Utility analysis “Siesta” method	DE04
	Financial methods of investment appraisal	Nominal	Cost/Benefit analyses Discounted cash flow | Net present value (NPV) Internal Rate of Return (IRR) Payback (breakeven) Real options Return on Investment (ROI) Total Cost of Ownership (TCO)	DE07
	Analytical & strategic techniques	Nominal	Critical Success Factors Decision Trees Strengths/Weaknesses analyses Return on Management (ROM) Scenario Technique	DE08
	Portfolio methods	Nominal	Bedell’s method Investment mapping (Benefits / Investment Focus) Investment portfolio (Contribution to business domain / contribution to technology domain)	DE09
	Do you know or use methods not mentioned?			DE10

References

Arnott, D., & Pervan, G. (2005). A critical analysis of decision support systems research. *Journal of Information Technology, 20*, 67-87.

Barclay, D., Higgins, C., & Thompson, R. (1995). The partial least squares (PLS) approach to causal modeling: personal computer adoption and use as an illustration. *Technology Studies, 2*, 285-309.

Baron, R. M., & Kenny, D. A. (1986). The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology, 51*, 1173-1182.

Barthélemy, J. P., Bisdorff, R., & Coppin, G. (2002). Human centered processes and decision support systems. *European Journal of Operational Research, 136*, 233-252.

Behzadian, M., Kazemzadeh, R. B., Albadvi, A., & Aghdasi, M. (2010). PROMETHEE: A comprehensive literature review on methodologies and applications. *European Journal of Operational Research, 200*, 198-215

Benbasat, I., & Todd, P. A. (1992). The Use of Information in Decision Making: An experimental investigation of the impact of computer-based decision aids. *MIS Quarterly*, 373-393.

Bernroider, E. W. N. (2008). IT Governance for Enterprise Resource Planning supported by the DeLone-McLean Model of Information Systems Success. *Information & Management, 45*, 257-269.

Bernroider, E. W. N., & Koch, S. (2001). ERP selection process in midsize and large organizations. *Business Process Management Journal, 7*, 251-257.

Bernroider, E. W. N., Koch, S., & Stix, V. (2010). Elements of Comprehensive Assessments of IT Infrastructure Projects in the Austrian Ministry of Finance. *Lecture Notes in Computer Science, LNCS 6267*, 84-91.

Bernroider, E. W. N., & Stix, V. (2006). Profile distance method - a multi-attribute decision making approach for information system investments. *Decision Support Systems, 42* 988-998.

Bharati, P., & Chaudhury, A. (2004). An empirical investigation of decision-making satisfaction in web-based decision support systems. *Decision Support Systems, 37*, 187-197.

Björnsson, H., & Lundegård, R. (1992). Corporate competitiveness and information technology. *European Management Journal, 10*, 341-347.

Bollen, K., & Lennox, R. (1991). Conventional wisdom on measurement: a structural equation perspective. *Psychological Bulletin, 110*, 305-314.

Bowen, P. L., Cheung, M.-Y. D., & Rohde, F. H. (2007). Enhancing IT governance practices: A model and case study of an organization's efforts. *International Journal of Accounting Information Systems, 8*, 191-221.

Bureau-van-Dijk. (2009). Analyse MAjor Databases from EUropean Sources (AMADEUS). In: Bureau van Dijk Electronic Publishing (BvDEP).

Butler, T., & Murphy, C. (2008). An exploratory study on IS capabilities and assets in a small-to-medium software enterprise. *Journal of Information Technology, 23*, 330-344.

Chang, H. H. (2006). Technical and management perceptions of enterprise information system importance, implementation and benefits. *Information Systems Journal, 16*, 263-292.

Chau, P. Y. K., & Tam, K. Y. (1997). Factors Affecting the Adoption of Open Systems: An Exploratory Study. *MIS Quarterly, 21*, 1-24.

Chen, W., & Hirschheim, R. (2004). A paradigmatic and methodological examination of information systems research from 1991 to 2001. *Information Systems Journal, 14*, 197-235.

Chin, W. W. (1998). The Partial Least Squares Approach to Structural Equation Modeling. In G. A. Marcoulides (Ed.), *Modern Methods for Business Research* (pp. 297). New Jersey: Lawrence Erlbaum Associates.

Chris, G., & Alessio, I. (2010). A Web-based decision support system with ELECTRE III for a personalised ranking of British universities. *Decision Support Systems, 48*, 488-497.

Churchhill, G., & Surprenant, C. (1982). An investigation into the determinants of customer satisfaction. *Journal of Marketing Research, 19*, 491-504.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2 ed.). Hillsdale, New Jersey: Lawrence, Erlbaum Associates.

Davern, M. J., & Wilkin, C. L. (2010). Towards an integrated view of IT value measurement. *International Journal of Accounting Information Systems, 11*, 42-60.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*, 319-340.
Doll, W. J., Deng, Z., Raghunathan, T. S., Torkzadeh, G., & Xia, W. (2004). The Meaning and Measurement of User Satisfaction: A Multigroup Invariance Analysis of the End-User Computing Satisfaction Instrument. *Management Information Systems, 21*, 222–263.
EC. (2008). *Statistical Classification of Economic Activities in the European Community, Rev. 2 (NACE Rev. 2)*. Luxembourg: European Communities
Eder, L., & Igbaria, M. (2001). Determinants of intranet diffusion and infusion. *Omega - The International Journal of Management Science, 29*, 233-242.
El-Kharbili, M., Markovic, I., Pulvermüller, E., & Stein, S. (2008). Towards a Framework for Semantic Business Process Compliance Management. In *GRCIS 2008*. Montpellier, France
Farbey, B., Land, F., & Targett, D. (1993). *How to Assess your IT Investment. A study of Methods and Practice.* Oxford: Butterworth Heinemann.
Fink, L., & Neumann, S. (2009). Exploring the perceived business value of the flexibility enabled by information technology infrastructure. *Information & Management, 46*, 90-99.
Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research, 18*, 39-50.
Gefen, D., Straub, D. W., & Boudreau, M.-C. (2000). Structural Equation Modeling and Regression: Guidelines for research practice. *Communications of the Association for Information Systems, 4*, 1-79.
Gunasekaran, A., Ngai, E. W. T., & McGaughey, R. E. (2006). Information technology and systems justification: A review for research and applications. *European Journal of Operational Research, 173*, 957-983.
Hardy, G. (2006). Using IT governance and COBIT to deliver value with IT and respond to legal, regulatory and compliance challenges. *Information Security Technical Report, 11*, 55-61.
Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in International Marketing. *Advances in International Marketing, 20*, 277-319.
Homburg , C., & Baumgartner, H. (1995). Beurteilung von Kausalmodellen - Bestandsaufnahme und Anwendungsempfehlungen. *Marketing - Zeitschrift für Forschung und Praxis, 17*, 162-176.
Howick, S., & Ackermann, F. (2011). Mixing OR methods in practice: Past, present and future directions. *European Journal of Operational Research, 215*, 503–511.
Ives, B., Olson, M. H., & Baroudi, J. J. (1983). The measurement of user information satisfaction. *Communications of the ACM, 26*, 785–793.
Joshi, K., & Pant, S. (2008). Development of a framework to assess and guide IT investments: An analysis based on a discretionary-mandatory classification. *International Journal of Information Management, 28*, 181-193.
Kaplan, R. S., & Norton, D. P. (1992). The Balanced Scorecard – measures that drive performance. *Harvard Business Review*, 71-79.
Karacapilidis, N. I., & Pappis, C. P. (1997). A framework for group decision support systems: Combining AI tools and OR techniques. *European Journal of Operational Research, 103*, 373-388.
Kordel, L. (2004). IT Governance Hands-on: Using COBIT to Implement IT Governance. *The Information Systems Control Journal*, 39-46.
Kuan, K. K. Y., & Chau, P. Y. K. (2001). A Perception-Based Model for EDI Adoption in Small Businesses Using a Technology-Organization-Environment Framework. *Information & Management, 38*, 507-521.
Kunsch, P. L., Kavathatzopoulos, I., & Rauschmayer, F. (2009). Modelling complex ethical decision problems with operations research. *Omega, 37*, 1100-1108.
Lai, K. H., Wong, C. W. Y., & Cheng, T. C. E. (2008). A coordination-theoretic investigation of the impact of electronic integration on logistics performance. *Information & Management, 45* 10-20.
Landsbergen, D., Coursey, D., & Loveless, S. (1997). Decision Quality, Confidence, and Commitment with Expert Systems: An Experimental Study. *Journal of Public Administration Research & Theory, 7*, 131-158.
Lankford, S. V., Buxton, B. P., Hetzler, R., & Little, J. R. (1995). Response Bias and Wave Analysis of Mailed Questionnaires in Tourism Impact Assessments. *Journal of Travel Research, 33*, 8-13.
Lee, B., Barua, A., & Whinston, A. B. (1997). Discovery and Representation of Causal Relationships in MIS Research: A Methodological Framework. *MIS Quarterly, 21*, 109-136.

Lee, L., Petter, S., Fayard, D., & Robinson, S. (2011). On the use of partial least squares path modeling in accounting research. *International Journal of Accounting Information Systems, 12*, 305-328.
Leidner, D., & Elam, J. (1995). The Impact of Executive Information Systems on Organizational Design, Intelligence, and Decision making. *Organization Science, 6*, 645-664.
Mackenzie, A., Pidd, M., Rooksby, J., Sommerville, I., Warren, I., & Westcombe, M. (2006). Wisdom, decision support and paradigms of decision making. *European Journal of Operational Research, 170*, 156-171.
Malhotra, N. K., Kim, S. S., & Patil, A. (2006). Common method variance in IS research: a comparison of alternative approaches and a reanalysis of past research. *Management Science, 52*, 1865-1883.
Matos, M. A. (2007). Decision under risk as a multicriteria problem. *European Journal of Operational Research, 181*, 1516-1529.
Mousseau, V., Figueira, J., & Naux, J. P. (2001). Using assignment examples to infer weights for ELECTRE TRI method: Some experimental results. *European Journal of Operational Research, 130*, 263-275.
Murphy, K. E., & Simon, S. J. (2002). Intangible benefits valuation in ERP projects. *Information Systems Journal, 12*, 301-320.
Negash, S., Ryan, T., & Igbaria, M. (2003). Quality and effectiveness in web-based customer support systems. *Information Management, 40*, 757-768.
Nunnally, J. C. (1978). *Psychometric Theory* (2 ed.). New York, USA: McGraw-Hill.
Park, J.-H., Suh, H.-J., & Yang, H.-D. (2007). Perceived absorptive capacity of individual users in performance of Enterprise Resource Planning (ERP) usage: The case for Korean firms. *Information & Management, 44*, 300-312.
Parker, M. M., & Benson, R. J. (1988). *Information Economics: Linking Business Performance to Information Technology*. London: Prentice Hall.
Petter, S., Straub, D., & Rai, A. (2007). Specifying formative constructs in information systems research. *MIS Quarterly, 31*, 623-656.
Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *Journal of Applied Psychology, 88*, 879-903.
Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management*, 69–82.
Reiner, J., & Stix, V. (2004). IT appraisal models and methodologies: a critical literature review. In *15th Information Ressource Management Association International Conference* (pp. 37-40). New Orleans.
Reiner, J., & Stix, V. (2006). IT-transformation Decision Processes: A Conceptual Framework for Efficiency/Effectiveness Optimization. *Communications of the IIMA, 6*, 51-62.
Remenyi, D. (1999). *IT-investment: making a business case*. Oxford, Boston: Butterworth Heinemann.
Renkema, T. J. W., & Berghout, E. W. (1997). Methodologies for information systems investment evaluation at the proposal stage: a comparative review. *Information and Software Technology, 39*, 1-13.
Ringle, C., Wende, S., & Will, A. (2005). SmartPLS 2.0 (beta). In: University of Hamburg.
Ross, J. W., & Beath, C. M. (2002). Beyond the Business Case: New Approaches to IT Investment. *MIT Sloan Management Review, 43*.
Roy, B. (1978). ELECTRE III: algorithme de classement base sur une présentation floue des préférences en présence de critères multiples. *Cahiers du CERO, 20*, 3–24.
Saaty, T. L. (1980). *The Analytic Hierarchy Process*. New York: McGraw Hill.
Sambamurthy, V., & Zmud, R. W. (1999). Arrangements for information technology governance: A theory of multiple contingencies. *MIS Quarterly, 23*, 261-290.
Shim, J. P., Warkentin, M., Courtney, J. F., Power, D. J., Sharda, R., & Carlsson, C. (2002). Past, present, and future of decision support technology. *Decision Support Systems, 33*, 111-126.
Siau, K., & Rossi, M. (2011). Evaluation techniques for systems analysis and design modelling methods - a review and comparative analysis. *Information Systems Journal, 21*, 249-268.
Simon, H. (1960). *The new science of management decision*. New York: Harper & Row.
Siriram, R., & Snaddon, D. R. (2004). Linking technology management, transaction processes and governance structures. *Technovation, 24*, 779-791.
Slovic, P., & Tversky, A. (1974). Who accepts Savage's axiom? *Behavioral Science, 19*, 368-373.

Smithson, S., & Serafeimidis, V. (2003). Information systems evaluation as an organizational institution - experience from a case study. *Information Systems Journal, 13*, 251-274.
Sohal, A. S., & Fitzpatrick, P. (2002). IT governance and management in large Australian organisations. *International Journal of Production Economics, 75*, 97-112.
Stanovich, K. E., & West, R. F. (1999). Discrepancies Between Normative and Descriptive Models of Decision Making and the Understanding/Acceptance Principle. *Cognitive Psychology*, 349–385.
Su, Y.-f., & Yang, C. (2010). Why are enterprise resource planning systems indispensable to supply chain management? *European Journal of Operational Research, 203*, 81-94.
Sutcliffe, K., & McNamara, G. (2001). Controlling Decision-Making Practice in Organizations. *Organization Science, 12*, 484-501.
Szulanski, G. (1996). Exploring internal stickiness: impediments to the transfer of best practice within the firm. *Strategic Management Journal, 17*, 27–43.
The-Standish-Group. (2009). The 2009 Chaos Report. In: Standish Group International.
Todd, P. M. (2007). How much information do we need? *European Journal of Operational Research, 177*, 1317-1332.
Todd, P. M., & Gigerenzer, G. (2000). Précis of Simple heuristics that make us smart. *Behavioral and Brain Sciences, 23*, 727-741.
Tornatzky, L. G., & Fleischer, M. (1990). *The process of technological innovation*. Lexington: Lexington Books.
Tsoukiàs, A. (2008). From decision theory to decision aiding methodology. *European Journal of Operational Research, 187*, 138-161.
Vaidya, O. S., & Kumar, S. (2006). Analytic hierarchy process: An overview of applications. *European Journal of Operational Research, 169*, 1-29.
Van der Stede, W. A., Mark Young, S., & Xiaoling Chen, C. (2006). Doing Management Accounting Survey Research. In A. G. H. Christopher S. Chapman & D. S. Michael (Eds.), *Handbooks of Management Accounting Research* (Vol. Volume 1, pp. 445-478): Elsevier.
Wei, C.-C., Chien, C.-F., & Wang, M.-J. J. (2005). A AHP-based approach to ERP system selection. *International Journal of Production Economics, 96*, 47-62.
Wiersma, E. (2009). For which purposes do managers use Balanced Scorecards?: An empirical study. *Management Accounting Research, 20*, 239-251.
Wixom, B. H., & Watson, H. J. (2001). An empirical investigation of the factors affecting data warehousing success. *MIS Quarterly, 25*, 17-41.
Wold, H. (1982). Soft modeling: the basic design and some extensions. In K. G. Jöreskog & H. Wold (Eds.), *Systems under indirect observations: Causality, structure, prediction. Part 2* (pp. 1-54). Amsterdam: North-Holland.
Xu, S., Zhu, K., & Gibbs, J. (2004). Global Technology, Local Adoption: A Cross-Country Investigation of Internet Adoption by Companies in the United States and China. *Electronic Markets, 14*, 13-24.
Yoon, K. P., & Hwang, C.-L. (1995). *Multiple attribute decision making: An introduction*. Thousand Oaks, CA: Sage Publications.
Zahra, S. A., & George, G. (2002). Absorptive Capacity: A Review,Reconceptualization,and Extention. *Academy of Management Review, 27*, 185-203.
Zhu, K., Kraemer, K. L., & Xu, S. (2003). Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors. *European Journal of Information Systems, 12*, 251-268.
Zhu, K., Kraemer, K. L., & Xu, S. (2006). The Process of Innovation Assimilation by Firms in Different Countries: A Technology Diffusion Perspective on E-Business. *Management Science, 52*, 1557-1576.
Zhu, K., Kraemer, K. L., Xu, S., & Dedrick, J. (2004). Information Technology Payoff in E-Business Environments: An International Perspective on Value Creation of E-Business in the Financial Services Industry. *Journal of Management Information Systems, 21*, 17-54.
Zhu, K., Xu, S., & Dedrick, J. (2003). Assessing Drivers of E-. Business Value: Results of a Cross-Country Study. In *Twenty-Fourth International Conference on Information Systems*. Seattle, WA, USA.