Managing user acceptance: an empirical investigation in the context of business intelligence standard software

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Abstract: This study suggests and tests a model for the systematic evaluation of management activities in company-wide standard software implementations using the example of a business intelligence (BI) software package. The proposed model builds on an extended technology acceptance model (TAM), previous research on IT implementation success factors and reviews of relevant change management variables. Using structural equation modelling, several hypotheses are tested. The investigated management variables demonstrate significant influences on the psychological acceptance factors included in the model. Seven out of ten hypotheses are confirmed. In addition, the model explains a substantial amount of variance in actual user behaviour measured with a system-based indicator. Practical implications for the implementation of company-wide standard software in organisations are discussed.

Keywords: technology acceptance; technology acceptance model; TAM; standard software; IT implementation; change management; management intervention.


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1 Introduction

Information technology (IT) systems are a central part of today’s organisational life. Organisations increasingly utilise the benefits associated with IT to improve business processes and organisational effectiveness (Davenport, 1998). In particular, the implementation of company-wide standard software defined as “configurable, off-the-shelf software packages that provide an integrated suite of systems and information resources for operational and management processes across a broad range of business activities” [Ward et al., (2005), p.97] usually implies major organisational changes, which must be managed successfully (Venkatesh et al., 2007). Examples of such company-wide standard software packages are ‘enterprise resource planning (ERP)’, ‘customer relationship management (CRM)’, ‘supply chain management (SCM)’, or ‘business intelligence (BI)’ systems.

Research indicates that the implementation of company-wide standard software in the workplace is often an expensive and time-consuming process that involves many problems, frequently resulting in project failure (e.g., Cooke et al., 2001; Standish Group International, 2009). In the case of ERP systems, up to 90% of ERP implementations did not meet either the time or cost estimations (Laukkonen et al., 2007), 40% of ERP systems achieved partial implementation, and 20% were considered as total failures (Trunick, 1999). Empirical studies focusing on critical success factors of implementing these software packages (e.g., Nah et al., 2003; Somers and Nelson, 2001) reiterate that viewing such software implementations as solely an IT project ignores important psychological factors that should be considered, both during and after the implementation process. In addition, several studies show that even if technical implementation difficulties are handled properly, most challenges arise from low levels of user acceptance and a lack of intention by organisational members to fully utilise new IT systems (Dillon and Morris, 1996; Gould et al., 1991; Nickerson, 1981). According to a study of the CIO executive board conducted in 2008, only 32% of target end users are willing to use company-wide standard software systems, such as ERP, CRM or BI systems. Results from this study also showed that acceptance and motivation problems are the highest barriers for effective implementation of such software packages. In this regard, Venkatesh and Bala (2008) note recently that previous research has also provided
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valuable insights into factors related to employees’ decisions to adopt new IT. However, few attempts have been undertaken to provide managers with information to improve their decisions about interventions that result in greater user acceptance and effective use of IT.

The awareness of the relevance of user acceptance and user behaviour for successful IT implementations in organisations has led to an increased focus on variables able to influence user adoption during the implementation process. These variables include aspects such as system characteristics (e.g., Davis, 1993; Igbaria et al., 1995; Wixom and Todd, 2005), organisational and leadership support (e.g., Igbaria et al., 1995, 1997; Karahanna and Straub, 1999; Rouibah et al., 2009), user training and information (e.g., Amoako-Gyampah and Salam, 2004; Bueno and Salmeron, 2008) or user participation (e.g., Barki and Hartwick, 1994; Jackson et al., 1997).

The systematic evaluation of IT acceptance factors and their relation to specific management variables might contribute significantly to the successful implementation of company-wide standard software. In this regard, organisational surveys, along with their subsequent analysis and data-based follow-up activities, have proved to be an effective and useful tool in the management of organisational change processes (Cinite et al., 2009; Holt et al., 2007; Kraut, 1996; Weiner et al., 2009) and have recently also been applied in the context of complex standard software implementation in organisations (e.g., Amoako-Gyampah and Salam, 2004; Bueno and Salmeron, 2008; Kwahk and Lee, 2008).

The assessment of psychological acceptance factors and management variables has the potential to provide important information for the successful implementation of company-wide standard software, and can be linked directly to available objective indicators of actual user behaviour. However, the survey-based evaluation and optimisation of management activities during and after the implementation of IT in the workplace is strengthened substantially when it builds on a clear conceptual model, integrating user acceptance and previous research on management activities in the context of IT implementation. This model should specify the intervention-outcome processes by explicating the cause-and-effect relationships through which interventions bring about results.

A model-based approach to the effectiveness assessment of social interventions has been highly praised in evaluation research (Chen and Rossi, 1987; Lipsey and Pollard, 1989; Scott and Sechrest, 1989; Smith, 1994). Such an approach has the potential to identify specific problems of user acceptance and their relation to management decisions. In addition, it also attenuates validity threats of the analysis and the conclusions (Chen and Rossi, 1987), and enhances insights in the generalisability of successful methods and activities for the management of IT implementation processes. Therefore, the model-based evaluation and optimisation of management activities in the context of standard software implementations should integrate perspectives of technology acceptance research and literature on critical success factors of IT implementations and change management, as well as evaluation research.

In sum, the main purpose of this study is to develop and empirically test a framework for the model-based evaluation of management activities in the context of company-wide standard software implementations, such as BI systems.

In this regard, we build on an extended technology acceptance model (TAM). Based on a review of change management literature and research on IT implementation success
factors, we suggest a framework for the integration of variables into the TAM that are relevant for the management of user acceptance when implementing standard software packages. In addition, this approach provides a helpful tool to guide management activities during the implementation of such complex software systems. Empirically, the study tests the proposed model. Furthermore, several hypotheses focusing on specific influences of management variables on end user acceptance factors of company-wide standard software are conducted and tested. Hence, this investigation demonstrates the usefulness of such an evaluation framework in guiding management decisions to increase user acceptance when implementing a BI system in the workplace.

2 Modelling technology acceptance

Much of the previous research related to technology acceptance focuses on the TAM originally proposed by Davis (1989) and Davis et al. (1989) and recently extended by Venkatesh and Davis (2000) and Venkatesh and Bala (2008). The TAM is the most widely used and empirically validated behavioural model available to explain differences in the acceptance and use of IT systems (King and He, 2006; Lee et al., 2003; Legris et al., 2003; Ma and Liu, 2004; Schepers and Wetzels, 2007; Youssafzai et al., 2007a, 2007b). It is based on the theory of reasoned action designed by Fishbein and Ajzen (1975), and attempts to explain and predict user acceptance of new IT systems (in relation to both intention to use the system and actual system usage).

The TAM assumes that the intention to use an IT system depends on two main belief factors that have been defined by Davis (1989): the first factor is the perceived usefulness of a system which refers to “the degree to which a person believes that using a particular system would enhance his or her job performance” (p.320). The second factor is perceived ease of use, which refers to “the degree to which a person believes that using a particular system would be free of effort” (p.320). The TAM also suggests that perceived usefulness is influenced by perceived ease of use. Thus, these factors influence intention to use an IT system, which ultimately determines actual system usage.

In recent years, many authors have argued that subjective norms, defined as “a person’s perception that most people who are important to him think he should or should not perform the behavior in question” [Fishbein and Ajzen, (1975), p.302], may play an important role in organisational contexts and, therefore, should be added to the TAM (e.g., Karahanna and Straub, 1999; Karahanna et al., 1999; Mathieson, 1991; Taylor and Todd, 1995; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000). Thus, the social influences of important referents (e.g., supervisors, colleagues, experts or consultants) have an effect on behavioural intentions. In addition, it is assumed that this psychological variable influences the perceived usefulness of a system (e.g., Schepers and Wetzels, 2007; Venkatesh and Davis, 2000).

The extended TAM constitutes one essential building block of the framework suggested for the model-based evaluation of management interventions. Even though the TAM provides an established and well-supported insight into psychological variables influencing user acceptance, the model only targets the main determinants of IT use and user intention, but does not specify explicitly external variables relevant in the
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implementation of IT in the workplace (Mathieson, 1991; Yousafzai et al., 2007a). However, Davis et al. (1989) point out that one of the key purposes of the TAM is to provide a basis for tracing the impact of external factors on variables related to IT acceptance (Venkatesh and Bala, 2008). Therefore, the TAM can be seen as a model that specifies the psychological acceptance variables, which mediate the influence between external variables and actual user acceptance. Although many external variables that relate to user acceptance have been identified (Lee et al., 2003; Yousafzai et al., 2007a), few attempts have been undertaken to integrate specific management variables into the TAM, even though these variables are particularly relevant with respect to guiding the implementation of company-wide standard software successfully (Venkatesh and Bala, 2008). As such, less is known about the applicability of the TAM in the context of such complex software packages, especially in the case of BI systems, and, in addition, which management variables have an incremental effect on the psychological mediators specified by the extended TAM.

Many external variables previously examined as antecedents of TAM’s key belief factors (e.g., Venkatesh and Bala, 2008) are less relevant, or only related indirectly, to specific management decisions when implementing company-wide standard software in organisations. Individual differences, for example, are not directly subject to management decisions and can only be influenced indirectly through concrete interventions, such as user training, information or support. From a managerial perspective, in order to evaluate and improve the implementation process of IT and its relation to user acceptance, it seems reasonable to focus on external variables that are more likely to be subject to managerial decisions and interventions. Drawing on general research on technology acceptance in standard software implementations, as well as the broader domain of organisational change literature, the following section provides a framework to structure and integrate important management variables in the context of IT implementation processes into the extended TAM.

3 Management of IT implementation processes

Many factors have been suggested as being relevant to the successful management of standard software implementation processes and user acceptance (e.g., Amoako-Gyampah and Salam, 2004; Bueno and Salmeron, 2008; Kerimoglu and Basoglu, 2005; Kwahk and Lee, 2008). Venkatesh and Bala (2008) listed four categories of determinants of user acceptance: individual differences (e.g., computer anxiety); system characteristics (e.g., output quality); social influences (e.g., image); and facilitating conditions (e.g., organisational support). This categorisation summarised various variables that have been shown to be generally related to perceived ease of use, perceived usefulness and subjective norms. The suggested categories provide a useful framework with regard to general antecedents of the TAM variables. However, this categorisation of external variables does not focus specifically on management aspects during the implementation of company-wide standard software in organisations, and includes categories of variables that are not directly subject to managerial interventions (e.g., individual differences). In a different approach, Kwahk and Lee (2008) proposed computer self-efficacy, organisational commitment and perceived personal competence as antecedents of perceived ease of use and perceived usefulness.
The authors further assume that the effects of organisational commitment and perceived personal competence are mediated by readiness for change. However, organisational commitment, self-efficacy and personal competence, again, do not reflect management variables that are directly subject to management decisions. Amoako-Gyampah and Salam (2004) proposed training, communication and shared beliefs as primary antecedents of the TAM variables in organisational IT implementation projects, putting a stronger focus on particular change management activities. Also, focusing on change management aspects, Kerimoglu and Basoglu (2005) listed communication, training and project management as important management interventions with respect to the TAM variables. Similarly, Bueno and Salmeron (2008) specified management support, communication, cooperation, training and technological complexity as change-relevant variables in terms of user acceptance in the context of company-wide standard software implementations.

Overall, the factors listed by different authors appear to vary substantially between studies, and few attempts have been undertaken to provide a systematic categorisation of management factors relevant to IT user acceptance in organisations during the implementation process. A model-based evaluation of management variables would benefit from the provision of a framework, structuring external management variables in IT implementations relevant to user acceptance and behaviour.

After an extensive review of the literature in the general domain of organisational change, Armenakis and Bedeian (1999) placed factors relevant to the success of organisational change initiatives into three categories: content, process and context factors. It seems useful to integrate this framework into the TAM to develop an integrated model for the evaluation of management interventions related to company-wide standard software implementation and user acceptance. Content factors are related to specific characteristics of IT systems. Dominant aspects of the IT system frequently found in the literature and subject to managerial decisions are quality of information provided by the system and system performance (e.g., DeLone and McLean, 1992; Liu and Ma, 2006; Wixom and Todd, 2005; Wixom and Watson, 2001). Process factors include variables that are most often the focus of change management activities. Related factors often include information and communication (e.g., Amoako-Gyampah and Salam, 2004), user support (e.g., Igbaria et al., 1997; Karahanna and Limayem, 2000), and user training (e.g., Amoako-Gyampah and Salam, 2004; Igbaria et al., 1995). Context factors refer to organisational conditions facilitating the implementation process. Management and leadership support could be considered as an important contextual variable (cf., Dong, 2001, 2006; Rouibah et al., 2009).

A comprehensive empirical approach should include central and relevant variables from all three categories, in order to analyse strengths and weaknesses of the implementation process with respect to user acceptance. Based on evaluation of content, process and context factors, the management can identify areas which require improvement, and derive concrete measures for their optimisation. Figure 1 depicts the full research model suggested for the evaluation of management activities in order to improve user acceptance of standard software implementations.

Within the three domains, we specified various central variables, previously discussed and considered as relevant for the company participating in this study to evaluate the implemented BI system. Consequently, five external variables were included in the research model.
Quality of information provided by the BI system and system performance refer to the content category. According to Wixom and Todd (2005), the quality of information can be explained by four criteria: Completeness refers to how well the software system provides all information necessary for the execution of tasks. Accuracy depicts how error-free and precise system data is from the user’s point of view. Format defines how system information is prepared and displayed. Finally, currency represents users’ perception of how up-to-date system data is.

A high quality software system (i.e., correct, accurate, well displayed and current) is more likely viewed as useful for the users and their work (Saeed and Abdinnour-Helm, 2008; Venkatesh and Bala, 2008). In the context of standard software, Lai and Yang (2009) and Lai et al. (2006) showed a significant influence of quality of information on perceived usefulness ($\beta = .32$, $p < .01$ in both studies). Therefore, the following hypothesis is derived:

Hypothesis H1a The quality of information has a positive influence on the perceived usefulness of the BI system.

Usually, standard software systems integrate different business functions and processes on the basis of a shared database (Davenport, 1998). Therefore, the quality of system output for a specific user is highly dependent on the extent of data quality ensured by other users working with the standard software. If important referents (e.g., colleagues and managers) of a specific user rate the data quality provided by the system very highly, this will have a positive influence on whether these referents recommend using the system. Thus, it is more likely that social norms evolve regarding the system usage if the data quality is perceived as excellent. Consequently, we assume:
Hypothesis H1b The quality of information provided by the BI system has a positive influence on the subjective norm.

The second content variable highlights facets of the quality of the system performance such as system stability, downtime, and report availability or response time and is defined as system performance. Wixom and Todd (2005) identified five general quality characteristics for IT-systems: Reliability explains how reliably a system works for the user; flexibility refers to the possible adjustments of the system to users’ demands. Integration focuses on the options of the system to gather and to process data from different sources. Accessibility refers to the simplicity to access information from the system and to extract it from the system. Finally, speed indicates the turnaround of the system to users’ demands, specifically the execution of tasks. End users prefer systems with a good performance and therefore use them more regularly (Igbaria et al., 1995). Moreover, system users evaluate not only whether the system contributes to a better task achievement, but also how well the system is executing the tasks (Venkatesh and Davis 2000). A study by Wixom and Todd (2005) demonstrated a strong correlation between the satisfaction with system performance and perceived ease of use ($\beta = .81, p < .01$). Furthermore, Liu and Ma (2006) also showed a significant influence of system performance on perceived ease of use ($\beta = .68, p < .01$). Thus, the following hypothesis can be formulated:

Hypothesis H2 System performance has a positive influence on perceived ease of use of the BI system.

User information refers to the process variables and depicts the amount, frequency, and clarity of information concerning system changes and improvements. It is viewed as a crucial factor of successful implementation of company-wide standard software (e.g., Al-Mashari et al., 2003; Nah et al., 2003; Sarker and Lee, 2003; Somers and Nelson, 2001; Welti, 1999). Furthermore, new information, if accepted by the individual, can lead to a change of existing beliefs or to the generation of new beliefs (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975). Consequently, user information on possible benefits of the use of new standard software might cause changes of the user’s attitude towards the system use. Additionally, information about the system is usually not merely addressed to the end user but also to specific reference groups (e.g., executive managers, experts or key users) of the end user. These reference groups might communicate that the use of the system is requested or expected. Thus, user information is not only able to serve as a pure transfer of knowledge (e.g., benefits of the system or how to use it), but also indirectly via reference groups to influence end users’ normative beliefs concerning the system use. Hence, we assume:

Hypothesis H3a User information on the BI system has a positive influence on the subjective norm.

With the implementation and the use of complex standard software, several (groups of) employees with different expectations and levels of knowledge are involved (e.g., users, executive managers, works council). Information and communication activities mainly focus on the benefits of using the system and the consequences of the system implementation. Furthermore, details on process changes concerning the implementation need to be communicated as well as system demonstrations (Al-Mashari et al., 2003). Thus, information and communication activities represent a way for spreading
knowledge about the standard software throughout the organisation and contribute to the formation of positive beliefs about the standard software (Aladwani, 2001; Amoako-Gyampah and Salam, 2004). In addition, knowledge about the benefits of the system helps users to form their own opinion on the new or updated system. Therefore, it is expected that information and communication activities influence the perceived usefulness of a software system. Furthermore, users are quite commonly supported with post-implementation information on how to use the system, e.g., lists with frequently asked questions, tips and tricks (Amoako-Gyampah and Salam, 2004). Thus, following hypotheses can be formulated:

Hypothesis H3b User information on the BI system has a positive effect on the perceived usefulness of the system.

Hypothesis H3c User information on the BI system has a positive influence on the perceived ease of use.

The second process variable, user training, is a crucial factor for the success of the implementation of standard software (e.g., Al-Mashari et al., 2003; Bingi et al., 1999; Nah and Delgado, 2006), and moreover an important factor for the influence on user acceptance (e.g., Amoroso and Cheney, 1991; Igbaria et al., 1995; Schillewaert et al., 2005; Venkatesh and Bala, 2008). Usually new competencies for end users are required with the implementation of company-wide standard software. Especially, if the implementation causes extensive process changes when legacy systems are replaced by a new software system (Bingi et al., 1999; Nah et al., 2001; Somers and Nelson, 2001). The content of the training should not only focus on the system itself (new functions), but also refer to processes, e.g., changed working and administrative processes (Al-Mashari et al., 2003; Shields, 2001; Somers and Nelson, 2001). Therefore, training programmes offer a great opportunity for system users to get used to these changes and to develop positive beliefs towards the new system (Aladwani, 2001). User training allows the user to test the new system (or a prototype) already before the implementation and to form beliefs about its usefulness and usability (Amoako-Gyampah and Salam, 2004; Igbaria et al., 1995). However, most of the previous studies on user training were conducted in the context of simpler software systems, e.g., e-mail or word processing programmes (Venkatesh and Bala, 2008). As company-wide standard software systems are more complex and sophisticated (Kwahk and Ahn, 2010) and take a central role in the users’ working life (Venkatesh and Bala, 2008), training programmes are assumed to have a higher importance for those systems compared to their simpler counterparts. Several studies demonstrated an effect of training programmes on both perceived usefulness and perceived ease of use (Amoako-Gyampah and Salam, 2004; Bueno and Salmeron, 2008; Igbaria et al., 1995, 1997; Rouibah et al., 2009; Yi and Davis, 2001). Thus the following hypotheses are derived:

Hypothesis H4a User training has a positive influence on the perceived usefulness of the BI system.

Hypothesis H4b User training has a positive influence on the perceived ease of use of the BI system.

The context variable management refers to the support by the management during the implementation process as well as to the continuous improvement of the system after
implementation. However, most studies on user acceptance focused only on the general influence of the management on perceived usefulness and perceived ease of use (Dong et al., 2007) with heterogeneous results (e.g., Igbaria et al., 1995; Lewis, Agarwal and Sambamurthy, 2003). Consequently, this study focuses on the more specific variable top management support. Several researchers pointed out the importance of top management support as a determinant for a successful standard software implementation (e.g., Al-Mashari et al., 2003; Bingi et al., 1999; Dong, 2001; Nah et al., 2003; Somers and Nelson, 2001). Top management usually decides on the implementation of company-wide standard software systems due to the high investments required for such projects. Furthermore, top management also communicates the high priority of such a project for the organisation and provides the necessary financial and personal resources (Bueno and Salmeron, 2008; Nah et al., 2001). Top management commitment with respect to the implementation of standard software can also enhance employees’ commitment to the software (Bingi et al., 1999; Dong, 2001; Nah et al., 2003; Sarker and Lee, 2003). Moreover, top management decisions and behaviour affect norms and values of an organisation (Yukl, 1998). Therefore, top management behaviour in terms of selection and implementation of a standard software package is also assumed to have an influence on subjective norms concerning the software. Igbaria et al. (1996) demonstrated the influence of management support on the subjective norm focusing on personal computers ($\beta = .14, p < .05$). Thus, we assume:

Hypothesis H5a Top management support has a positive influence on the subjective norm.

Furthermore, top management is involved in the implementation process (e.g., as sponsor) and supervises it continuously. This visible support of a project by the top management can enhance the perceived usefulness of the standard software (Dong et al., 2007; Lewis et al., 2003). Several studies demonstrated that top management support lead to a better system use (e.g., Cheney et al., 1986; Dong et al., 2007; Fuerst and Cheney, 1982; Guimaraes et al., 1992; Igbaria et al., 1990; Rouibah et al., 2009).

For example, Dong et al. (2007) corroborated a direct correlation between the leadership behaviour of a project sponsor and perceived usefulness ($\beta = .31, p < .01$). In another study, Rouibah et al. (2009) also showed a correlation between top management support and perceived usefulness ($\beta = .32, p < .05$). As several studies on a general influence of management support on perceived usefulness also demonstrate this effect (Igbaria and Iivari, 1995; Igbaria et al., 1995, 1997), the following hypothesis is derived:

Hypothesis H5b Top management support has a positive effect on the perceived usefulness of the BI system.

4 Method

4.1 Sample

The analysis is based on the Brazilian employees of a multinational organisation. All employees participating in the survey were active users of a BI standard software
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The system was implemented in several waves, on a global scale within the organisation. The main purpose of this implementation was the standardisation and harmonisation of planning and reporting processes, as well as empowering employees at all levels with the right information and knowledge to support decisions in their role. The company’s main objective of this study was to identify areas for improvement to increase user acceptance towards the implemented BI system. In total, 1,683 active BI users were invited to participate in the survey. The survey achieved an overall response rate of 48%. We excluded all participants with more than three missing values on the variables measured in the model, as well as those who did not participate in BI system training, resulting in a sample of 258 participants for the subsequent analysis.

4.2 Measures

The items used to operationalise the theoretical constructs in this study were adapted from prior research, with changes in the wording to fit the target context. The constructs of the TAM model were adapted from the original scales provided by Davis (1989) and Davis et al. (1989). Four items were used to measure perceived usefulness (e.g., “Overall, I find the BI system useful for my job”), four items to measure perceived ease of use (e.g., “Overall, I find the BI system easy to use”), and three items to assess behavioural intention (e.g., “Overall, I am motivated to use the BI system as often as possible for my role”). Internal consistency for these scales ranges from .950 for perceived usefulness to .902 for perceived ease of use, and .814 for behavioural intention.

Three additional items (e.g., “My supervisor expects me to use the BI system for my role”) were written to measure subjective norm, adapted from the scale provided by Taylor and Todd (1995). Internal consistency for this scale in the sample is .899.

The two external variables related to the content category are quality of information and system performance. Three items, based on Wixom and Todd (2005), are used to operationalise the quality of information (e.g., “The BI system provides correct information”). The scale shows an internal consistency of .784. Three items adapted from Liu and Ma (2006) are used to measure system performance (e.g., “In general, the BI system response time is adequate to perform my role”), with an internal consistency of .866 for this scale. Two variables are related to the process category: user training (e.g., “The level of detail of BI system training in terms of features (e.g., drill down, filter, personalisation) was adequate”) and user information (e.g., “I am satisfied with the clarity of information I received about BI system changes and improvements”) are measured, with three respectively four items adapted from Amoako-Gyampah and Salam (2004). Internal consistency for these scales ranges from .909 (training) to .956 (information). Top management support is the only context variable measured with three items (e.g., “Senior management supports the implementation and continuous improvement of the BI system”) adapted from Igbaria et al. (1997). The scale reaches an internal consistency of .958. All items were measured on a five-point Likert scale, ranging from 1 (strongly agree) to 5 (strongly disagree).

In addition, we used an objective indicator of actual user behaviour. Actual use of the system was measured by the number of attempts to access the system in order to actively retrieve information over a period of twelve months. This number was divided by
the number of months to obtain an indicator of average user behaviour over a period of time.

4.3 Analyses

To test the derived hypotheses and the adequacy of the postulated model we applied structural equation modelling (SEM; Bollen, 1989) using the software package AMOS 18.0. For this analysis, each variable was modelled as a latent factor, with only its corresponding items linked to this factor. The loading of a single item for each factor was fixed at 1.0 to set the scale of the factor.

The overall model fit was assessed using the comparative fit index (CFI), the incremental fit index (IFI), and root mean square error of approximation (RMSEA). The CFI and IFI have been shown to be relatively less susceptible to violations of multivariate normality compared to other indices of fit (West et al., 1995). The RMSEA has the advantage of providing an index of error per degree of freedom, a known sampling distribution and a result that takes into account model complexity. Values of .90 or above for CFI and IFI, and values of .08 or lower for RMSEA, are usually taken as evidence of adequate model fit (e.g., Dieffendorff et al., 2005; Hu and Bentler, 1999; Vandenberg and Lance, 2000).

5 Results

Table 1 provides an overview of the scale means, standard deviations, and intercorrelations of the variables examined in the model. The test of the structural equation model demonstrated a good fit of the model to the observed data ($\chi^2 = 797.861$, df = 409; CFI = .944; IFI = .944; RMSEA = .061), since all fit indices meet the commonly accepted cut-off values (Vandenberg and Lance, 2000).

The psychological acceptance factors reflected by the TAM show consistent relationships as proposed in the extended TAM, except for the influence of perceived ease of use on perceived usefulness. Perceived usefulness ($\beta = 0.161$, $p < .05$), perceived ease of use ($\beta = 0.592$, $p < .01$) and subjective norm ($\beta = 0.221$, $p < .01$) all influence behavioural intention significantly, with perceived ease of use being the strongest predictor of behavioural intention. All three determinants of intention together explain 60% of its variance. In addition, behavioural intention ($\beta = 0.398$, $p < .01$) significantly predicts the actual use of the system measured by the objective indicator, and explains about 16% of its variance. Perceived ease of use ($\beta = 0.115$, n.s.), however, did not have a significant influence on perceived usefulness. Considering the content variables associated with the BI system, quality of information is strongly related to perceived usefulness ($\beta = 0.458$, $p < .01$), and moderately related to subjective norms ($\beta = 0.249$, $p < .01$). Thus, hypotheses H1a and H1b receive support in this study. As assumed in Hypothesis H2, system performance has a significant effect on perceived ease of use ($\beta = 0.298$, $p < .01$). Hence, all hypotheses regarding the content factors are confirmed.
### Table 1
Means, standard deviations, intercorrelations of scale means and scale reliability

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
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<td>1 Quality of information</td>
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<td>.784</td>
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<tr>
<td>2 System performance</td>
<td>2.407</td>
<td>0.675</td>
<td>.466**</td>
<td>.866</td>
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<tr>
<td>3 Training</td>
<td>2.517</td>
<td>0.744</td>
<td>.379**</td>
<td>.460**</td>
<td>.909</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Information</td>
<td>2.607</td>
<td>0.742</td>
<td>.535**</td>
<td>.493**</td>
<td>.431**</td>
<td>.956</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Top management support</td>
<td>2.036</td>
<td>0.707</td>
<td>.293**</td>
<td>.321**</td>
<td>.296**</td>
<td>.187**</td>
<td>.958</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Perceived usefulness</td>
<td>2.219</td>
<td>0.764</td>
<td>.642**</td>
<td>.476**</td>
<td>.402**</td>
<td>.369**</td>
<td>.950</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Perceived ease of use</td>
<td>2.501</td>
<td>0.861</td>
<td>.478**</td>
<td>.494**</td>
<td>.526**</td>
<td>.483**</td>
<td>.227**</td>
<td>.499**</td>
<td>.902</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Subjective norm</td>
<td>2.042</td>
<td>0.657</td>
<td>.359**</td>
<td>.324**</td>
<td>.322**</td>
<td>.231**</td>
<td>.469**</td>
<td>.448**</td>
<td>.263**</td>
<td>.899</td>
<td></td>
</tr>
<tr>
<td>9 Behavioural intention</td>
<td>2.242</td>
<td>0.76</td>
<td>.399**</td>
<td>.360**</td>
<td>.480**</td>
<td>.312**</td>
<td>.326**</td>
<td>.503**</td>
<td>.645**</td>
<td>.408**</td>
<td>.814</td>
</tr>
<tr>
<td>10 Use of system</td>
<td>126.126</td>
<td>198.010</td>
<td>.135*</td>
<td>.126*</td>
<td>.298**</td>
<td>-.034</td>
<td>.102</td>
<td>.223**</td>
<td>.246**</td>
<td>.287**</td>
<td>.356**</td>
</tr>
</tbody>
</table>

Notes: *p < .05, **p < .01

Diagonal elements represent Cronbach’s alpha reliabilities.
The process variable user information is assumed to influence all acceptance factors significantly. However, only the effect of user information on perceived ease of use turned out to be significant ($\beta = 0.152$, $p < .05$). Therefore, Hypothesis H3c is confirmed whereas hypotheses H3a and H3b could not be proven. The second process variable, user training, is a significant determinant of perceived ease of use ($\beta = 0.374$, $p < .01$), as stated in Hypothesis H4b. Hypothesis H4a predicts a positive effect of user training on perceived usefulness of the BI system, which could not be confirmed in this study ($\beta = 0.028$, n.s.).

The context variable top management support is strongly associated with subjective norm ($\beta = 0.425$, $p < .01$). Furthermore, top management is moderately associated with perceived usefulness ($\beta = 0.112$, $p < .05$). Therefore, both hypotheses H5a and H5b receive support in this study. In sum, 70% of the conducted hypotheses are confirmed based on the results of this investigation. Figure 2 shows the results of the tested research model.

**Figure 2** Test of research model

6 Discussion

The implementation of company-wide standard software in organisations, such as BI systems, constitutes a major organisational change process (Venkatesh et al., 2007). Low levels of user acceptance appear to be a major hurdle in the implementation process of IT (Dillon and Morris, 1996; Gould et al., 1991; Nickerson, 1981) and lead to huge challenges for the management (e.g., Venkatesh and Bala, 2008). Recently, management
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research and practice emphasised the survey-based evaluation and optimisation of management activities (Cinite et al., 2009; Holt et al., 2007; Weiner et al., 2009). In this regard, survey research has been suggested as an important instrument to evaluate and support major organisational change initiatives.

Based on the TAM (Davis, 1986, 1989; Davis et al., 1989) as well as on a framework of organisational change variables (Armenakis and Bedeian, 1999), this study proposed and tested a model that specifies the intervention-outcome processes between management variables and technology acceptance in organisations, as suggested by the theory-based evaluation approach (Chen and Rossi, 1987; Lipsey and Pollard, 1989; Scott and Sechrest, 1989; Smith, 1994). Following the purpose of this study, only external variables subject to managerial decisions and interventions were included in the model and several hypotheses were derived. However, the list of relevant factors in managing IT acceptance during the implementation process seems to vary substantially between authors (e.g., Amoako-Gyampah and Salam, 2004; Bueno and Salmeron, 2008; Kerimoglu and Basoglu, 2005; Kwahk and Lee, 2008). Therefore, based on the review of Armenakis and Bedeian (1999), we suggest organising the external variables into the three categories of content, process, and context factors. Overall, the model demonstrated a good fit to the data and 70% of the hypotheses were confirmed. As such, this study contributes to a broader generalisability of the TAM within the context of company-wide standard software, especially in the case of BI systems. Furthermore, it supports previous results depicting the influences of several management variables on psychological acceptance factors.

With respect to the TAM, the results are quite heterogeneous to previous TAM research. Perceived ease of use has the strongest influence on behavioural intention. Two reasons may account for this result. First, standard software packages, such as the BI system in this study, tend to be complex regarding their user interface (Venkatesh and Bala, 2008). Thus, users may rate the relevance of ease of use for their intention to use the system in the context of perceived usefulness and subjective norms more highly. Second, the cultural background of the Brazilian survey sample may have moderated the relationship between ease of use and intention. Brazil is high on the cultural dimension of uncertainty avoidance (Hofstede, 1980), and high uncertainty avoidance is ascribed to feel uncomfortable in unstructured situations, which are unclear, complex, and ambiguous (Veiga et al., 2001). Therefore, uncertainty avoidance could have a strong influence on perceived ease of use within the TAM (Veiga et al., 2001), especially in the context of complex standard software packages.

Also, the specified management variables demonstrate a good fit to the proposed structure. Results in this implementation case show that from a management perspective, perceived ease of use can be influenced most strongly by improving end user training as stated in Hypothesis H4b. Additionally, system performance is significantly related to perceived ease of use (H2), whereas user information moderately influences perceived ease of use (H3c). Subjective norm is managed best by increasing top management support (H5a), whereas perceived usefulness is most strongly dependent on efforts in relation to the quality of information (H1b) and moderately dependent on management support (H5b). Furthermore, quality of information is moderately related to subjective norm (H1a). One key advantage of understanding the determinants of perceived ease of use, perceived usefulness, and subjective norms is the opportunity for management interventions to manipulate user perceptions about a BI system, via the underlying
psychological processes. However, some of the assumed paths in the model turned out not to be significant. Both process variables (user information and user training) seem to have no effect on perceived usefulness. A possible reason for this result might be the focus of information and training activities on usability aspects (e.g., system functionality, navigation) rather than on the benefits of reports and KPI’s for the daily work and decision making. Additionally, user information showed no effect on subjective norm in this study. This result could also be caused by the limited focus of information activities. For example, if such activities do not convey and reiterate clear management expectations towards using the BI system, it is unlikely that others build their opinion about system usage upon this information. Consequently, subjective norms will not be impacted by information activities.

7 Implications for research

Future application and research, using the suggested model or related models, could provide valuable information about the stability of management variables in their relationship with particular technology acceptance factors. Our research indicates that external variables have a significant influence on psychological variables, such as perceived ease of use, perceived usefulness, and subjective norms.

Repeated application of the model across time and organisations would either indicate a strong and stable relationship between particular external variables and particular TAM variables, or would help to identify important moderators of the relationship between management variables and technology acceptance factors. Some management activities might be, for example, particularly relevant for certain TAM variables in different phases of IT implementation projects, or under certain conditions. The model-based evaluation of IT implementation projects regarding user acceptance would open the opportunity for the examination of these moderators (e.g., duration since implementation, type of IT system, sample characteristics, etc.).

Longitudinal designs would also increase the validity of the causal assumptions of the model, and would help to reduce the frequently mentioned problem of common method variance (CMV) in TAM research (Lee et al., 2003; Straub and Burton-Jones, 2007). With respect to the efforts to reduce CMV effects in TAM research, this study measured actual usage behaviour with an objective indicator. Although behavioural intention is significantly related to actual usage, the variance explained in usage behaviour is small. This leads to the question of whether the suggested model is sufficient for prognosticating actual user behaviour. It might be beneficial in the context of standard software packages to include control aspects into the model, because using these software packages is generally mandatory. Therefore, it can be assumed that actual user behaviour is not completely under the volitional control of end users, but individuals can only carry out their intentions successfully if they have sufficient volitional control (Ajzen, 1991). In order to improve behavioural predictions for using company-wide standard software, the proposed model should be extended by the variable perceived behavioural control from the theory of planned behaviour (Ajzen, 1991).

Another reason for the low level of variance explained in actual user behaviour may lie in the conceptualisation of the objective indicator. The chosen indicator refers only to the frequency of using the software system. It may not capture all relevant facets of BI
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system usage (e.g., intensity or quality of usage). Future research should aim to define more appropriate measures for user behaviour of company-wide standard software.

8 Implications for practice

The analysis based on SEM provides practitioners with information on management activities that are, currently, most relevant, with respect to user acceptance of company-wide standard software. The management aspects with the strongest influence on behavioural intention, but also critically evaluated by the users, should be the focus of improvement activities. Furthermore, the model helps to specifically pinpoint improvement potential for the design and arrangement of management activities. For example, the current model test indicates that training has a strong influence on perceived ease of use, but no effect on perceived usefulness. This might imply that the overall effect of training activities could be improved by incorporating elements to explain the goals and organisational advantages of the system use more clearly, but also by making training examples more related to daily business tasks; aiming to improve the perceived usefulness of systems. In addition, the repeated evaluation of management and user acceptance variables has the potential to demonstrate developments over time, and evaluate the effectiveness of measures taken to improve management decisions on IT implementations.

On the other hand, system performance has a moderate influence on perceived ease of using the BI system in this case. Continuous improvement of the BI system regarding response time, system stability, downtime, and report availability will have a positive effect on perceived ease of use and consequently on user acceptance.

Furthermore, the survey itself acts as an intervention, which indicates the importance of different topics to end users and gets large user groups involved, actively and effectively, in the implementation and optimisation processes. In addition, the analysis of quantified acceptance factors, from an end user’s point of view, makes the need for action transparent and pursuable for decision makers, and can be used to ‘unfreeze’ (Lewin, 1947) the organisation as suggested by survey-feedback interventions.

Actions based on this model are suitable for the assessment of a new implementation of company-wide standard software, as well as for an upgrade of existing standard software solutions. Separate implementation projects and entire programmes can also be evaluated by these means. Ultimately, the presented approach offers an organisation the opportunity for an internal or external knowledge transfer; for instance, within project and process benchmarks.

9 Conclusions

Following the three major objectives of this approach, the results of this study demonstrate the applicability of the TAM within the context of BI standard software packages, and contribute to the generalisability of the TAM to this specific IT context. This is especially important since this type of standard software has been implemented more often during recent years with an increase of the overall user base. Furthermore, the a priori definition of an intervention-outcome process lends credibility to the internal
validity of the findings. Moreover, the conducted hypotheses show that the model-based evaluation of management activities, related to the implementation of BI software in organisations, provides valuable information for the optimisation of the implementation process, as well as the prioritisation of management interventions and resource allocation in practice.

However, the model suggested here, distinguishing between content, process and context factors in the evaluation of management activities and linking those to factors related to technology acceptance, seems to be a useful framework to guide action during the implementation not only of BI software but also of other complex standard software packages. Punctual or repeated assessments of factors specified in the model can serve as an important management tool to steer, optimise and evaluate management activities related to the implementation of such software packages.

References


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