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TOWARDS A CONSOLIDATED RESEARCH MODEL FOR UNDERSTANDING BUSINESS INTELLIGENCE SUCCESS

Christian Schieder

Peter Gluchowski

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Schieder, Christian, Chemnitz University of Technology, Thueringer Weg 7, 09131 Chemnitz, Germany, christian.schieder@wirtschaft.tu-chemnitz.de

Gluchowski, Peter, Chemnitz University of Technology, Thueringer Weg 7, 09131 Chemnitz, Germany, peter.gluchowski@wirtschaft.tu-chemnitz.de

Abstract

Research about the factors that determine the success of information systems (IS) suggests that IS success is an elusive phenomenon that can only be explained in terms of a multi-dimensional construct. Despite the usefulness and unique qualities of Business Intelligence (BI) solutions, the factors responsible for the success of BI solutions remain poorly understood. Our article attempts to illuminate a path towards a clearer understanding of how BI solutions succeed by drawing on the existing body of literature and critically reflecting on the updated model of information systems success presented by DeLone and McLean (2003) and Wixom and Watson's (2001) model of data warehousing success. The principal research contribution consists of expanding, adapting, and synthesising these two models into a consolidated model for BI success. We derive a second order model, delineate its constructs, and conceptualise their relationships based on prior research related to IS success. The operationalization of these factors has the potential of leading to a more precise instrument for understanding, evaluating and analysing the success of BI solutions.

Keywords: IS Success, Business Intelligence, Data Warehousing, Success factors.

1 Introduction

Concepts, tools, and software systems discussed under the umbrella term Business Intelligence (Clark et al. 2007) have helped fundamentally shape enterprise decision support (Alter 2004). Despite the paramount importance of BI for today's enterprises (Gartner 2009) there is a lack of research concerning the assessment of BI system's success. It might induce some unrest in CIO's sleep not having a dedicated and generally accepted model for determining if and to what extent the implementation of a core IS solution like BI is successful (Lönnqvist and Pirttimäki 2006, Arnott 2008) making the research into this question a highly relevant one.

As the impact of IS is often largely intangible, standard capital budgeting methods are often not comprehensive enough to adequately assess their success (Urbach et al. 2009). Thus, purely budgetary estimations of IT success that rely on a quantitative comparison of cost versus benefit are bound to fail, or are incomplete at best. This is especially the case with respect to BI (Lönnqvist and Pirttimäki 2006). Therefore, researchers have proposed a range of IS success models to approach the elusive phenomenon of IS success in terms of a multidimensional construct (Rockart 1982, Petter et al. 2008).

Drawing on this stream of research, the purpose of this paper is to present an instrument which measures and explains the success of BI. Our results are based on an analysis and synthesis of established models for the success of IS and data warehousing. Subsidiary goals include a more detailed consideration of the constructs that constitute the models along with their anticipated connections and causalities. In the course of this discussion we will also present the factors that underlie the constructs and outline basic approaches for their operationalization.

The remainder of the paper is structured as follows: Section 2 presents the foundations of BI and the models that form the theoretical basis for this elaboration. Next, Section 3 outlines the synthesis of the model and its adaptation to the domain of BI. Section 4 details the constructs that are used and justifies the derivation of corresponding success factors for BI by drawing on a review of BI-related literature. The final section summarises the results, gives an insight into possible modifications and proposes additional research to validate the proposed model.

2 Business Intelligence

In the past few years, the term Business Intelligence (BI) has become a synonym for innovative IT solutions for company planning and controlling, at first in the realm of pure practice and later in the realm of business science as well (Baars and Kemper 2008). BI applications have become the top spending priority of corporate information technology organizations and BI is one of the few areas of technology that are still growing (Davenport 2010, Foley and Manon 2010).

Today, BI is understood as a data driven decision support system (DSS) that combines data gathering, data storage, and knowledge management with analysis in the interests of better managerial decision making (Lawrence et al. 2010, Watson 2009, Negash 2004). In this way, BI represents an integrated IT concept that offers sustainable and interlinked solutions to achieve a range of system requirements necessary for providing information and analysis (Baars and Kemper 2008, Clark et al. 2007). The associated functions are provided by a number of different software components whose seamless interaction represents a constituent feature of BI.

From a technological perspective, BI includes all tools and applications that encompass an element of decision-making support that leads to a better understanding of the company's own business and thus to a better understanding of the mechanisms of relevant functional chains (Foley and Manon 2010). Specifically, these are components that extract, clean, transform, integrate, and store information that is relevant for decision-making, as well as building blocks for the dissemination, presentation, and analysis of this content (Lawrence et al. 2010). Transferred to today's system and concept landscape, this includes all necessary data integration tools (referred to as ETL-Tools for extraction, transformation and loading (of data)), Data Warehouses (which form the infrastructural basis for BI), and analysis applications (Watson 2009).

In contrast to the purely tool and application-oriented perspective of BI, a further, more process-focussed, conception exists. From this perspective, BI represents a process that captures, accesses, understands, analyses, and turns company, market and competitor raw data from fragmented and inhomogeneous sources into actionable information for the purpose of improving business performance (Foley and Manon 2010).

3 IS and DW Success Models

3.1 Success Model Selection

As explained above, we understand BI as an IS, comprising a set of processes, tools, and IT-infrastructure aiming at the accumulation, integration, analysis, and provisioning of information to foster enterprise decision making. Therefore, to assess the success of BI, a model of IS success might outline the general structure of a BI-specific model. Additionally, models explaining the success of infrastructural components might provide evidence on how to specify general models to the BI-domain. Thus, we conducted a literature review, trying to obtain models explaining IS success in general and the success of BI-related (sub-)IS in particular.

The models we identified to be especially applicable include DeLone and McLean's (1992 and 2003) model for measuring the success of information systems (hereafter D&M model) and Wixom and Watson's (2001) model for measuring the success of data warehousing (hereafter W&W model). We chose these two models based on both quantitative and qualitative arguments. From a quantitative perspective their widespread adoption in the literature as indicated by citation count as estimated by Google Scholar confirms the models' acceptance. For the time of the creation of this work (early 2011) the citations amount to 3491 citations for the D&M model of 1992 and 1628 citations for the updated D&M model of 2003. There were 437 citations for the data warehouse-specific model of Wixom and Watson. The qualitative argument concerns the adequacy of each model for explaining the success of BI. As a basic model, we prefer the D&M model over Davis' technology acceptance model (Davis 1989). While TAM has proven value in explaining the voluntary adoption of hedonic IS, the D&M model seems to be more suitable in explaining the success of utilitarian IS (Petter et al. 2008). Most enterprise IS fall into the latter category. Users depend on these systems to accomplish certain functional tasks according to the requirements of their job, hence we favour the D&M model. With regard to BI-related IS models, W&W's DW success model is the only one model that has been published in a reputable journal and has gained attention from researchers concerned with the exploration, explanation und understanding of the success factors for data warehousing (e.g. Ramamurthy et al. 2008) and related domains (e.g. Ariyachandra and Frolick 2008).

3.2 DeLone and McLean's IS Success Model

The D&M model has attracted considerable attention as a method for determining the success of information systems (DeLone and McLean 2004). Using a comprehensive taxonomy of heterogeneous concepts drawn from research on IS success, the authors presented an extensive reference system for IS success factors (DeLone and McLean 1992). Their original paper was based on the evaluation of 100 empirical tests conducted on success measures for (management) information systems between 1981 and 1987. A large number of authors, including both critics and proponents, considers the model to be one of the key contributions in research regarding success factors for IS (Urbach et al. 2009, Kaiser and Ahlemann 2010). They originally discriminated several factors that could be used for the indirect measurement of IS success. These included the categories of *system quality*, *information quality*, *system use*, *user satisfaction*, and *effects* (individual and organisational).

In 2003 DeLone and McLean presented an updated version of the model, principally modified in three respects in response to several criticisms of the model. The revised model added an additional dimension for *service quality* (1) in order to incorporate both the products of the IS function and the services associated with it (Pitt et al. 1995). The *use* dimension was supplemented with an *intended use* element (2) in order to counter criticism regarding the mix of process and causal model Seddon (1997). These two effects dimensions are combined into the broader construct of *net benefit* (3) so as to be able to subsume effects at an individual, group-specific, and organisational level. The term “net” is intended to emphasise the positive connotation of dependant variables (DeLone and McLean 2003). Figure 1 graphically summarises the updated model. The arrows between the constructs indicate presumed effect correlations. Thus, *information quality*, *system quality*, and *service quality* influence *(intended) use* and *user satisfaction*, with *net benefit* feeding back on use and satisfaction.

A number of empirical analyses have confirmed the correlation between these dimensions and success for the original D&M model. There have also been a range of validating studies and applications from different domains for the revised model. In addition, there have been a large number of respecification and operationalization recommendations for other domains. Urbach et al. 2009 provide an overview of the state-of-the-art of research related to the D&M model.

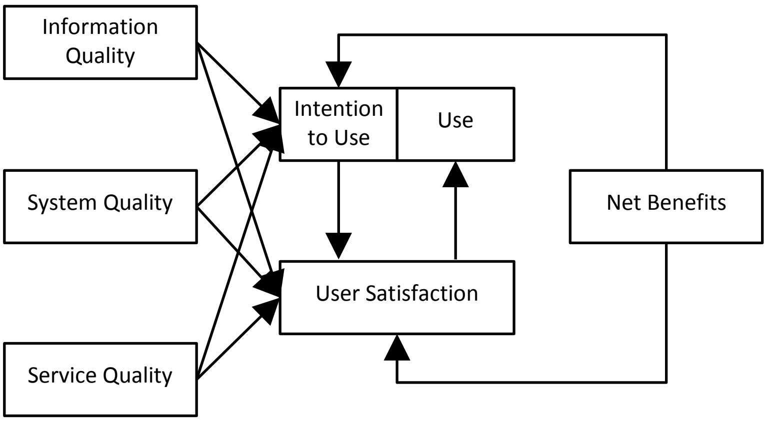

Figure 1. DeLone and McLean’s updated model for measuring the success of information systems (reproduced from DeLone and McLean 2003).

3.3 Wixom and Watson’s Data Warehouse Success Model

As mentioned above (c.f. section 2) data warehousing forms the technological basis for BI and thus constitutes an important element for the success of BI. In 2001, Wixom and Watson presented a model for analysing the success of enterprise data warehousing initiatives (Wixom and Watson 2001). Conducting a multi-stage analysis, the authors determined the factors that are responsible for the implementation success of data warehouse systems. A confirmatory study surveying decision-makers from 111 organisations was intended to ensure the validity of the derived constructs and the assumed relationships among them. The results confirmed a close link between *system quality* and *information quality* on the one hand and *perceived benefits* on the other.

The constructs were designated as organisational implementation success, project-related implementation success and technical implementation success. According to Wixom and Watson (2001), the introduction of a data warehouse is successful if the project team responsible for its introduction succeeded in implementing the system on time (*project implementation success*), overcame technical issues (*technical implementation success*) and generated acceptance for the system within their organisation (*organisational implementation success*). The successful introduction as a whole, as well as each underlying construct, determined the quality of both the information and the system. *Data quality* is conceptualised interchangeably with *information quality* in DeLone and McLean (1992). Concerning *system quality*, the authors emphasise the importance of flexibility and integration for a successful system implementation. The system must be able to react flexibly to the constantly changing information needs of the decision makers (Vandenbosch and Huff 1997), and to integrate data from a variety of heterogeneous data sources. If these factors are met, the model predicts successful system implementation with broad adoption by decision-makers, resulting in reduced time and reduced costs for decision-making and a deeper understanding of the decision context.

Wixom and Watson go on to identify individual success factors that affect the success of the introduction. These includes *management support*, the availability of a executive-level project sponsor (*champion*), the supply of sufficient budget, staff, and time *resources*, active *user participation* in system design, a high level of *team skills*, the quality and accessibility of *source systems*, and the applied *development technology*. Figure 2 graphically summarises their proposed model, and only depicts confirmed effects. The strength of the arrows reflects the intensity (path co-efficient) of the connection between the factors. The strength of the box lines depicts the variance share (R^2-value), which is explained by the model parameters in a construct.

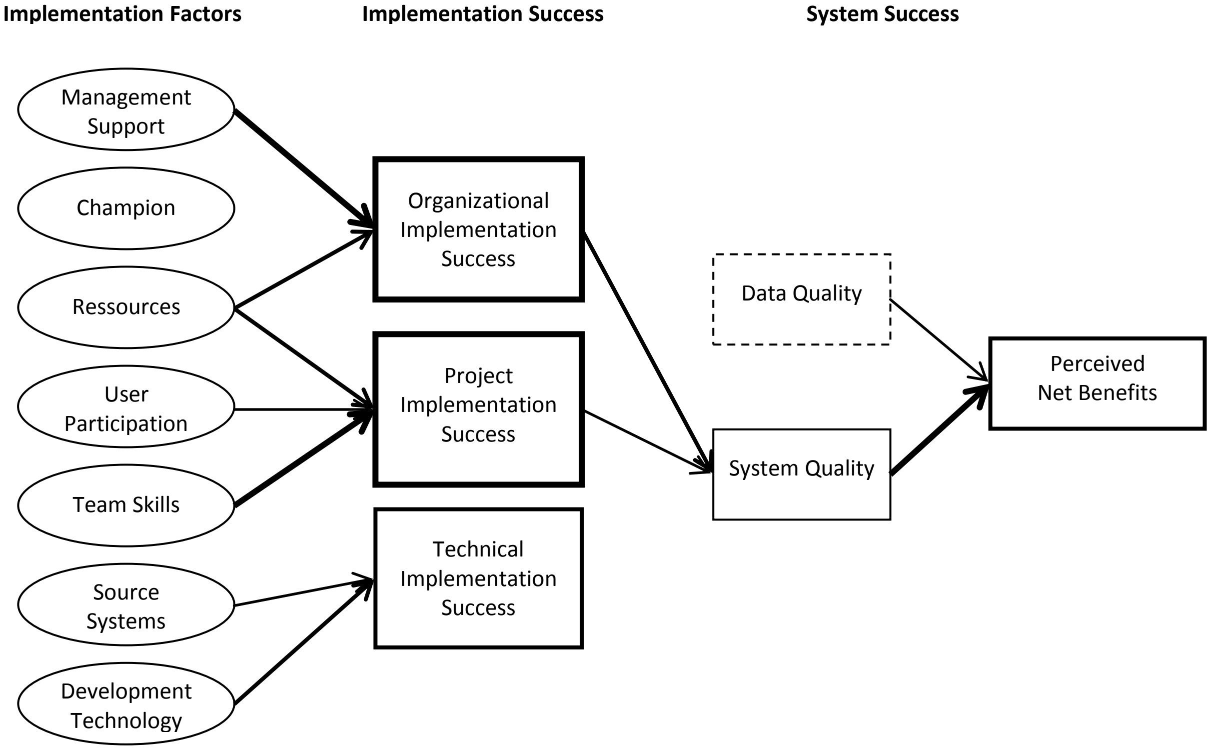

Figure 2. Model for measuring the success of data warehousing by Wixom and Watson (2001) – depicting confirmed correlations only.

It is immediately apparent that the suggested model can only explain a relatively small share of the variance leading to DW success. *Data quality* (R^2=0.016) is only marginally explained by the implementation success factors, and *system quality* (R^2=0.128) only to a small degree. This leads to the conclusion that other parameters not included in the model must play a major role in *data* and *system quality*. *Technical implementation success* has no effect on system success. Wixom and Watson (2001) attribute this to the fact that key technical difficulties have already been overcome prior to the system's operation phase. The model explains *organisational* and *project-related implementation success* relatively well (R^2=0.419/0.435). *Management support* appears to be a key organisational factor and *team skills* present the most important project-related factor.

4 Model Critique, Synthesis and Adaptation

The rather low explanatory power of the W&W model (i.e., the model can only explain just over one-third of the variance of *perceived net benefits*) can be traced back to at least three possible deficiencies: two underlying assumptions for the model must be considered as questionable (C1, C2) and the validity of the base model used must be considered as being too limited (C3):

(C1) Wixom and Watson explicitly omitted use and user satisfaction constructs established in previous research on success factors. They justified their decision by stating that with infrastructure systems such as the data warehouse, it would be difficult to identify users (Wixom and Watson 2001, p. 20). But how can requirements be fixed if is not clear who will use the system?

(C2) Furthermore, they imply that the success of a data warehousing initiative can best be evaluated by data suppliers (Wixom and Watson 2001, p. 25), since end-users might have a distorted view of data warehousing because they only have indirect access to using application systems. However, they do not explain how data suppliers can assess the relevance and usefulness of the data for consumers.

(C3) Another point of criticism concerning W&W's model is that it uses the original (1992) D&M model, which has been considered obsolete since 2003 (DeLone and MacLean 2003). This model serves as the starting point and thus is the basis for the model construction. As a result, the service quality construct and its associated aspects are left out.

Considered together, these points suggest that a modification of the W&W model is required to explain data warehousing success in particular and BI success in general. Nevertheless, we can assume that the model provides valuable hints regarding the assessment of BI success. The following section therefore presents a proposal for synthesising the updated D&M model with a modified version of the W&W model. Our proposal explicitly addresses the deficiencies identified in the W&W model by specifying the updated D&M model to the context of BI.

Observations concerning specific characteristics of BI form the basis for our argumentation. The following conflicting demands described in the literature particularly distinguish the targeted capabilities of BI solutions from other forms of enterprise IS:

(D1) **Demand for adaptability**: the knowledge gained using BI solutions is intended for specific and, with regard to their information needs, heterogeneous user groups. Besides information consumers at the executive level, the targeted audience also includes other management levels as well as external stakeholders (Davenport 2010). BI must be capable of adapting to different user environments.

(D2) **Demand for assimilability**: there is a continuously increasing trend towards embedding BI in decision-making processes at the operational business level (Marjanovic 2010). The goal is to streamline and accelerate decision-making in manual or semi-manual process tasks as well as to automate certain decisions. Thus, the insights and knowledge provided by BI not must not only be consumable by humans but also by other IS.

(D3) **Demand for flexibility**: the changing nature of decision processes leads in turn to a high level of volatility in system requirements. This goes on to create specific demands with respect to the flexibility of the system configuration (Vandenbosch and Huff 1997, Clark et al. 2007).

(D4) **Demand for comprehensiveness**: BI solutions must cover a wide range of organizational IT and work systems. They are forced to be far-reaching horizontally because they integrate numerous operational IS (e.g. ERP, CRM, etc.). Additionally, enterprises seek extensive vertical integration to include as many levels of the enterprise as possible (Alter 2004, Vandenbosch and Huff 1997).

These conflicting demands lead us to the assumption that a BI success model might be more complex than the general IS success model. This does not imply that ascertaining the factors for BI success as such is a more difficult task than in other domains, but the resulting model with its relationships of constructs and success factors (BI success as a whole) yields a comparatively higher complexity. For example a key finding of Wixom and Watson (2001) is that the information quality and system quality constructs cannot be conceptualised as latent exogenous variables, as presumed by DeLone and McLean (2003). Rather, they are to be understood as latent endogenous variables, preceded by a layer of latent exogenous variables (Petter et al. 2007). The same must be assumed for the service quality construct. Thus, taking the work of Wixom and Watson (2001) into account, our central design step is to expand the D&M model with an additional layer of exogenous constructs (see Figure 3).

Specifically, we introduce three new constructs that we assume precede information quality, system quality, and service quality. We name these three constructs *functional coverage*, *technical sustainability*, and *organisational maturity*. Their designation and specification is based upon on a review of BI-related literature and encompasses our own critique of the W&W model as well as other critiques raised in the IS success literature. The following section introduces the constructs in detail and demonstrates how the common IS success constructs presented by DeLone and MacLean and others can be adapted to the domain of BI.

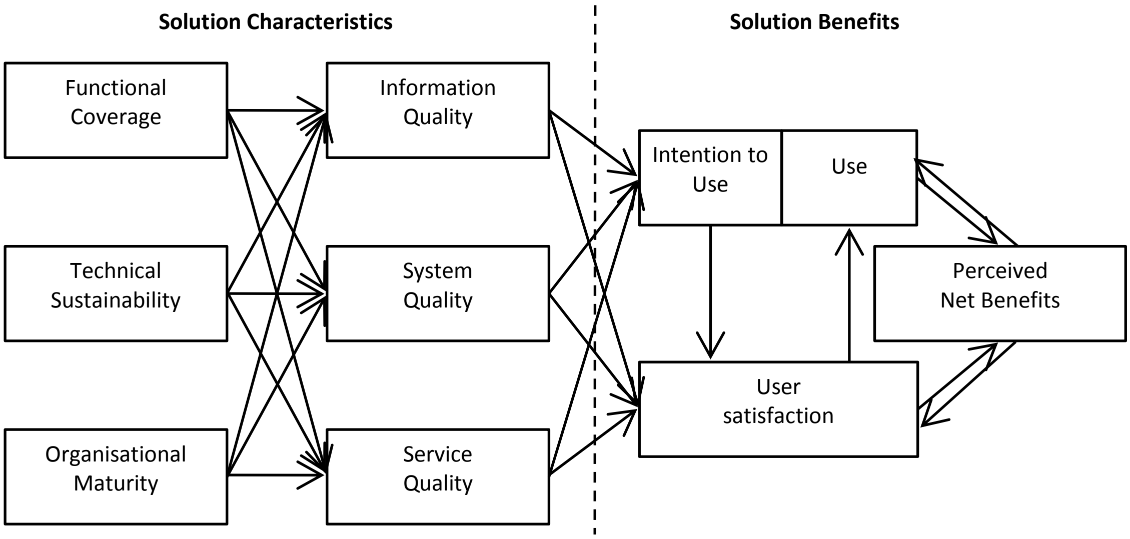

Figure 3. Consolidated research model for Business Intelligence success.

5 Constructs and Success Factors

Functional Coverage relates to the question of how effectively the BI solution addresses relevant operational business issues, for instance, those arising from system operations, and in what way it ensures that new functional tasks receive timely and effective support, e.g. during system design (Kaiser and Ahlemann 2010). The type of functional coverage required is determined by the individual functional context, which in turn has to match organisational (e.g. departmental, enterprise, or corporate) and individual (e.g. workplace) perspectives (Seddon 1997). At the enterprise level, these factors include the conditions of the economic environment for deployment of the system (branch, competitive intensity, company size, etc). The individual conditions represent the specific tasks to be accomplished at each individual workplace (for example, in a manager's workplace planning, decision making, and steering activities). This means that the functional coverage can only be assessed in the perspective of the specific deployment situation of a BI solution. Functional coverage is further affected by appropriate consideration of legal regulations (Hocevar and Jaklic 2010). In this context, management of functional metadata is a principal factor for success (Watson and Wixom 2010). This includes guaranteeing the enterprise-wide definition and correct use of technical terminology.

Technical Sustainability comprises factors related to the technical components and architectures of a BI solution (Arnott 2008, Kaiser and Ahlemann 2010). The technical complexity of a BI solution often requires a high level of diversity in tools and processes, which are applied along the course of designing and operating the system (Hamid et al. 2010). Against this background, understanding the success of BI depends greatly upon understanding how the components that are used interact and how adaptable their structures are from a technological perspective. Additional factors promoting the success of BI include the level of automation of data warehouse operations and the scope of standardisation (Watson and Wixom 2010). Technical integration into the operational system world is increasingly becoming a requirement for BI (Marjanovic 2010, Miori et al. 2010). The challenge of meeting this requirement grows with increasing levels of heterogeneity in the operational systems to be integrated and decreases with the use of open interfaces and standards. In this context, consistent administration of technical metadata plays a key role (Watson and Wixom 2010). Moreover, technical sustainability is greatly affected by issues concerning the future viability of the components in use. Last but not least, the continuous growth in data volumes places scrutiny upon aspects of parallelisability of BI architecture components as well as their scalability.

Organisational Maturity refers to the level of development of organisational structures and processes in the context of a BI solution. Consolidating and extending the work of Wixom and Watson (2001), organisational maturity brings together both project and non-project related structure and process organisation criteria. With respect to system design, organisational maturity deals mostly with questions related to project organisation, but it also includes the strategic and regulatory integration of BI initiatives in a wider organisational context (Watson and Wixom 2010). Important indicators of maturity include the level of formalisation in design processes, the existence of defined requirements engineering, and the use of standardised software development process models. In system operation, questions regarding the allocation of responsibilities and the formalisation of operations management have been shown to be more relevant. The establishment of a BI competence center does not guarantee success by itself (Klesse and Winter 2006). It does, however, demonstrate that the need to regulate responsibilities has been identified and tackled, including the definition and implementation of a BI strategy, which is derived from and integrated into IT and business strategy (Unger et al. 2008). Additional functions of a BI competence center include BI portfolio planning, BI quality management, the deployment and operation of service management models (such as ITIL for BI) and an active change management concept. Financial considerations are vital for successful project controlling. Thus, BI investment planning activities, project cost accounting, monitoring of adherence to resource limits (monetary, staff, and time), and considerations about the total cost of ownership should be in evidence. The skill and experience of the project staff as well as continuous personnel development play a particularly important role in the sustainability of enterprise BI initiatives (Sakaguchi and Frolick 1997). Besides general resource availability, support from senior level management is considered one of the most critical organisational success factors (Wixom and Watson 2001, Arnott 2008). The proposed organisational maturity construct thereby covers a broad range of success factors that are closely associated with the organisation’s social and functional structure.

Information Quality represents an aggregate measure to assess content aspects of BI solutions (DeLone and McLean 1992; DeLone and McLean 2003). Guaranteeing sufficient information quality is a central aspect of both the design and operation of BI solutions (Popovic and Jaklic 2010). Information quality is one of the best studied constructs related to the success of IS. Wang and Strong (1996) analysed a total of 118 information quality attributes from the perspective of information consumers, aggregated these attributes into 15 factors, and distributed them in line with Wand and Wang (1996) into the four categories of intrinsic/inherent, contextual/purpose dependant, representative/preventative quality, and system-supporting/access quality. Nelson et al. (2005) set these categories against the four dimensions of the data warehouse environment: accuracy, completeness, actuality, and format. In addition, based on a comprehensive literature study of information quality constructs, they gathered and organised more than 70 individual data quality criteria for the operationalization of this model element.

System Quality represents the overall properties of the functional BI solution as a whole and its suitability for tackling issues of importance to users (Watson and Wixom 2001, DeLone and MacLean 2003). Analogous to their approach to information quality, Nelson et al. (2005) present a review that lists 29 system quality criteria found in the research literature. In line with Penska (2009) we consider the design of a graphical user interface (GUI) for BI solutions to be a core determinant of BI system quality. The ergonomics of the user interface, presentation aesthetic, user guidance (guided analytics), and system accessibility (single-sign-on) are all elements falling within the domain of the GUI design. Because of the need to undertake complex operations and the requirement for appropriate presentation of analysis results, the BI solution GUI is of great importance for the successful use of the IS. Additional IS success factors found in the literature include reliability, customisability, and performance/response time, all of which are also qualities that users expect from a BI solution (Nelson et al. 2005). The flexibility of a BI solution is reflected in the implementation duration for user requests, for example, and in the adaptability of functional and organisational structures and processes. Factor integration is also to be understood in a socio-technical systemic sense and extends beyond the simple, technically oriented integration of BI functionalities into the existing IT landscape (Hocevar and Jaklic 2010). Flexibility and integration can therefore be considered as design requirements that are working in opposite directions.

Service Quality relates to the quality of user support when using the system (Pitt et al. 2005). This dimension is of great importance for BI solutions, since the complexity of the solutions often leads users to have questions regarding the use of IS. Here, the analysed success factors were derived in a similar manner as the methods of Watson et al. (1998). They originate from the SERVQUAL instrument (Parasuraman et al. 1998) and are expanded and modernized by including troubleshooting, online service support, connection service, and the reachability of service staff. Trust in the service staff's expertise has particular importance in the context of BI. Support staff has to be well versed in the technical details of the end-user's tools and also have profound knowledge of business process procedures being used (Miori et al. 2010). In addition to these quasi-technical skills, users also expect a certain amount of friendliness, empathy, and communication skill from service staff. These skills are tested at times when recommended solution options need to be communicated.

(Intention to) Use defines the type, scope and intensity of usage of the BI solution. Intention to use and actual system use are considered viable constructs the can be used interchangeably depending on the purpose of the model (DeLone and McLean 1992; DeLone and McLean 2003). Actual system use can be analysed using quantitative and qualitative parameters. Examples for quantitative usage intensity parameters are the number of reports accessed, queries conducted, and the frequency and duration of use. An example of a qualitative measure would be the type of use, which indicates the level that the system has attained its goals. Another useful measure for the success of the solution is the continuing use of BI knowledge as part of the downstream business process. This might be particularly useful for measuring the success of operational BI (Marjanovic 2010). Depending in the specific situation the number of users can be used as an additional indicator of overall usage.

User Satisfaction is directed towards analyses of the user's attitude toward the system (DeLone and MacLean 1992, Poon and Wagner 2001, DeLone and MacLean 2003). The general question in this context is to what extent expectations regarding these quality dimensions have been met by the services provided, as subjectively perceived by users. An indicator of information quality here, for example, is the subjective assessment of the user concerning the fulfilment of their demand for information (Davenport 2010). Satisfaction with support provided for functional tasks can be used as an indicator in measuring user satisfaction regarding the functional coverage provided by the solution. Declining usage measures indirectly indicate declining satisfaction with the solution. Whether or not users enjoy using the solution has been proposed as another success factor regarding user satisfaction (Urbach et al. 2009).

Perceived Net Benefit. Perceived net benefit designates the core dimension for determining the diverse and multifaceted success of BI (Wixom and Watson 2001). Following DeLone and MacLean (2003) it represents all positive and negative effects of introducing BI into organizations from the perspective of all stakeholders affected. This includes the effects on the individual, group-specific and organisational levels within and outside of the enterprise. Internal effects include productivity changes as well as possible improvement (or deterioration) in transparency, the depth of business understanding and the adherence to regulatory requirements (Lönnqvist and Pirttimäki 2006). The foremost goal of BI is the acceleration and enhancement of decision-making processes (Davenport 2010). The reduction of decision-making latency, i.e. the time between the occurrence of a need for a decision and the decision being made and then implemented, increases the agility of an enterprise (Marjanovic 2010). Enhancements in decision-making processes fundamentally affect the consistency of decisions in similar situations. This in turn leads to enhanced transparency within the enterprise and provides assurance for staff. General accessibility to information in situations where it is necessary and appropriate not only increases job satisfaction for employees but also enables a better distribution of knowledge throughout the organisation. This in turn contributes to creating a competitive edge over competitors through knowledge advances. Therefore, perceived net benefit ultimately measures the contribution BI makes to meeting enterprise objectives and its effects on the entire control and regulation system of the enterprise from a governance standpoint.

6 Limitations, Future Research, and Summary

Drawing upon previous research we developed a survey instrument to support researchers and practitioners alike in evaluating the success of BI. Using a rigorous development process, we created a model anticipated to have a high level of explanatory power and outlined a model for measurement. We amplified the D&M model by incorporating extensions introduced by the W&W model. This enhanced approach may lead to a more differentiated view on BI success than could have been provided by the base model. We introduced constructs that incorporate success factors for BI as noted in the general BI research literature. In addition we adapted the common D&M model constructs to the BI domain as a way to delineate methods for operationalizing the consolidated BI success model.

Although we were able to lay out the constructs in some detail, modifications to existing construct measurement models and the introduction of new constructs make an extensive validation phase necessary (Straub et al. 2004, Kaiser and Ahlemann 2010). The validity aspects that need to be considered during the process of empirical validation include: content validity, construct validity, convergent and discriminant validity and reliability (Straub et al. 2004). We are anticipating a positive result regarding the content validity of the construct, since most of the constructs in our model were adapted from those already described in the literature. The pre-study phase interviews with BI experts currently in progress might prove helpful in formulating and matching a sufficient number of measurement items for the proposed constructs. Additionally Quaing (2010) only recently published the results of his works in which he could demonstrate the validity of a BI-adapted D&M model explaining large portions of successful BI solutions.

Summarizing the results of our attempt to generate a model for measuring the success of BI, we were able to show that ascertaining the success of BI appears to be a more complex task than determining IS success in other disciplines. As it is generally accepted that IS success is a complex phenomenon (Petter et al. 2008), any attempt to somehow conceive IS success realistically will inevitably lead to a certain complexity within the developed models themselves. Accordingly the increase in the complexity of the model, may have a positive influence upon the model variables' explanatory power, but at the same will require greater effort in deploying the instrument as part of an empirical study. Recent research from neighbouring domains indicates that even more complex models might be necessary; for example, the net benefits dimension might be split up to discriminate between individual, workgroup, and organizational net benefits (for example, see Kaiser and Ahlemann 2010). In any application of the developed model researchers will have to deal with a trade-off between measurement precision and measurement feasibility. Nevertheless, the additional effort may be justified, since it can bring us closer to a long sought after means to assess and compare cost and benefit aspects of BI solutions. Organizations implementing BI could gain guidance on where to focus their attention in conducting BI projects. Organizations operating BI solutions could benefit by being able to assess the current state of their solution and be aided in carving out future paths for development.

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