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# MEASURING PROJECT MANAGEMENT INFORMATION SYSTEMS SUCCESS - TOWARDS A CONCEPTUAL MODEL AND SURVEY INSTRUMENT

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## Abstract

*Project management information systems (PMIS) are an important building block of efficient and effective project management. They have changed considerably in the last decades, starting as mere scheduling applications and now serving as complex systems covering a wide range of project processes and addressing a multitude of stakeholders. Vendors of PMIS frequently claim that these systems yield numerous benefits on the individual, workgroup and organisational level. To date, however, there is no empirical support for this claim. Also, there is still considerable uncertainty with regard to the factors influencing the success of a project management information system. This paper proposes a model for PMIS success based on the revised IS Success Model by DeLone and McLean (2003). We also suggest an accompanying survey instrument which was extensively validated using qualitative interviews, a Q-sorting/item ranking procedure and a quantitatively evaluated pre-test with 45 participants.*

Keywords: IS performance assessment; IS success/failure; Conceptual modelling; Statistical methods

# 1 INTRODUCTION

Most projects of medium to high complexity use a project management information system (PMIS) for planning and coordination (Pollack-Johnson and Liberatore 1998). Project managers have traditionally used them to support the creation of sophisticated plans, including scheduling, resource management and project cost accounting (Riis et al. 1987). Their scope has broadened and the more sophisticated systems enable organisations to not only manage individual projects, but whole project portfolios as well. Furthermore, vendors have added support for most phases of the project life cycle from the idea generation, to project risk and stakeholder management, to the management of created knowledge long after a project's conclusion (Ahlemann 2007). Most of these new features are not necessarily useful for individual users, although they are for the organisation as a whole. Vendors promise an improved resource allocation, lower overall risk and better budget control. Indeed, the implementation and widespread use of PMIS is based on the belief that their costs are offset by these promised benefits.

However, the benefit of project management information systems has not yet been investigated on an organisational level. As yet, it is also unclear which of a PMIS's properties most influence its use and its users' satisfaction. On the one hand, this lack of inquiry into the topic is certainly due to the more sophisticated PMIS being relatively young: notable multi-project management capabilities have only been added to most systems during the past five to ten years. On the other hand, the importance of projects, as a way of structuring organisations, has increased dramatically (Whittington et al. 1999) and project-related issues have therefore only recently become more appealing as fields of research.

In the light of (multi-)project management's increasing importance and the number of PMIS installations rising accordingly, it is essential that the benefits of PMIS can be clearly demonstrated. Only then can their often very resource intensive implementation be justified. In our view, it is also crucial to identify the factors contributing to their usage and user satisfaction. Knowledge of these factors could contribute to PMIS implementations from the requirements engineering to the change management during their introduction.

The intention of our research is to construct a conceptual model explaining the main factors of PMIS success. This will support us in answering the questions whether there are significant benefits realisable from the use of a PMIS. Furthermore, we will be able to ascertain the factors that are most influential in determining the extent of those benefits. This paper will thus present the construction of a valid survey instrument that can be used to conduct inquiries into PMIS success. Moreover, from a theoretical perspective, we will extend the revised IS Success Model (ISSM) bv DeLone and McLean (2003) to accommodate its application in complex enterprise applications that affect several organisational levels. Our research project is still in progress and using the tools presented in this paper, we intend to conduct a large-scale survey to answer the questions raised above.

Following this section, we provide some background on the concepts and theories employed in this paper. We specifically describe the foundational research with regard to IS success and project management information systems. Thereafter, a section on our methodological approach follows. We present the model by providing an overview of the constructs, their relationships in the conceptual model, and the included controls. Finally, we point out the model's limitations and conclude this paper with a description of the current state and future direction of our research project.

# 2 FOUNDATIONS

## 2.1 Project Management Information Systems

We define a project management information system as an information system that specifically supports one or several areas of project management practice as defined by the Project Management Institute's (PMI) Project Management Body of Knowledge (PMBoK). The crux of a PMIS is usually project management software that requires extensive adaption, configuration or customisation prior to its use. When using the term PMIS, we draw on a wide understanding of project management, including project programme and project portfolio management. Consequently, PMIS may not only address project managers but also other project stakeholders, such as team members, line managers, resource manager or project management office (PMO) staff. Accordingly, PMIS may have impacts on three different levels: (1) On an *individual level*, they may assist project stakeholders to carry out their project-management-related tasks. (2) On a *workgroup level*, PMIS may facilitate communication and collaboration between project team members. (3) Finally, PMIS may impact the entire organisation, for example, by supporting investment decision-making as part of project portfolio management (*organisational level*). These impacts are the result of a breadth of functionality offered by current PMIS, which cover the entire project life cycle and all management levels involved (Ahlemann 2007).

What sets PMIS apart from other classes of information systems that have been researched with regard to their success determinants is the highly volatile nature of their usage context. Project environments, being by definition unique (Project Management Institute 2004), require PMIS to be more customizable in their functionality than most other enterprise information systems (Ali et al. 2008). PMIS do not only have to initially adapt to the requirements of an organisation but also continuously match variable project requirements originating from project-specific governance, organisation, complexity, strategic importance, etc..

To date, research on PMIS has mainly focused on (1) algorithms for operations research problems related to project management (e.g., Chang et al. 2001); (2) the assessment and comparison of commercial project management software and the corresponding assessment frameworks (Kolisch and Hempel 1995); (3) the development of prototypes to test new kinds of functionality (e.g., Kurbel 1994); and (4) research on the usage of project management software (e.g., Hayek 1993). PMIS adoption and success has only recently been subject to two studies: Ali, Anbari, and Money (2008) analysed the impact of organisational and project factors on the acceptance and usage of PMIS and discovered that higher project complexity and the level of information quality explain PMIS usage. Raymond and Bergeron (2008) did a similar study and confirmed the role of the information quality. Moreover, they showed that positive impacts (in the sense of benefits) on the project manager will ultimately lead to higher project success.

## 2.2 Research on Information Systems Success

IS success is a rather multi-faceted phenomenon that lacks a widely accepted definition. Instead, the success is socially constructed and may depend on affected stakeholders' perspectives (Bartis and Mitev 2007). The definition of IS success may actually vary in respect of different types of IS that yield different benefits for individuals, workgroups and organisations (Seddon et al. 1999). A first synthesis of the manifold perspectives on IS success and its underlying antecedents was achieved by DeLone and McLean (1992), who developed an IS success model. This model has received much attention from IS scholars and can be regarded as one of the most prominent and influential models in IS research.

DeLone and McLean's IS Success Model (ISSM) refers back to research conducted in the 1970s and 1980s. The model's theoretical foundation is based on Shannon and Weaver's (1949) theory of communication as well as Mason's (1978) communication systems approach. The model's premise is that there is a temporal process model explaining how IS are adopted and applied by their users (DeLone and McLean 1992): An IS offers various features characterised by the two fundamental constructs: *system quality* and *information quality*. Users and managers experience these features by actually working with the system. Consequently, they are either satisfied or dissatisfied. The use of the system has an influence on the way users conduct their work. This individual impact may ultimately result in organisational impacts.

In general, the ISSM needs domain-specific adaptation (DeLone and McLean 2003), which means adapting the success dimensions' definition and constructs that directly relate to IS's properties of interest. However, DeLone and McLean recommend reusing as many constructs and measures as possible so that the research results can be compared and findings validated. Subsequent to its publication, various studies have tested and confirmed the model's propositions (e.g., Rai et al. 2002). Consequently, it can be considered a stable theoretical foundation for IS success research.

Nevertheless, several researchers have criticised the original model and made suggestions for improvement (Rai et al. 2002; Seddon 1997).DeLone and McLean responded to this criticism by offering an advanced and updated version of their model (DeLone and McLean 2003). The most important enhancements of the ISSM are that they add *service quality* as an additional construct, since personal computing and, subsequently, individual user support have become more important since the model's original development. Furthermore, DeLone and McLean combined individual and *organisational benefits* with the new construct *net benefits* in order to account for IS's diverse and multifaceted success. In addition, they consider *intention to use* and *system use* viable alternatives.

# 3 METHODOLOGY

In order to create a model that explains PMIS success, we relied on DeLone and McLean's (2003) updated model as a basis for the construction of PMIS success's conceptual model and its operationalisation. To gain insight into the modifications required to fit the model to PMIS, we gathered various qualitative empirical material. The quasi-volitional nature of PMIS use in most organisations qualifies the model of DeLone and McLean under the condition of careful measurement of the use dimension (Rai et al. 2002). Alternative models (e.g.Sabherwal et al. 2006; Seddon 1997) were evaluated but discarded due to a mismatch with our research questions and the respective context of the survey.

In order to adapt the ISSM to our needs, we determined the scope and typical functions of PMIS, thereby identifying the typical usage scenarios in which to measure the successful use of the software. Of particular relevance was the question: On which levels can benefits be achieved through the use of PMIS? To measure this, we evaluated a product study's database containing assessments of 54 project management software products' functions determined between 2006 and 2007 (Ahlemann 2007). Since the features of PM systems only informed us of the potential usage scenarios, we had to determine the actual usage of these systems in business environments. To that end, we conducted a series of 15 interviews with PM professionals from medium to large companies. They were asked in which context and for what purposes they used PMIS. We further followed the recommendation to use as many existing constructs and measurement indicators as possible (Bharati and Chaudhury 2004; DeLone and McLean 2003). Therefore, we analysed the appropriateness of measurement indicators used in similar studies. Where necessary, we amended or complemented the pre-existing items (Dillman 2008). Subsequently, we created an item pool with viable items for each construct. We also standardised the measurement scales of all the items to seven-point Likert scales (1: "Strongly disagree" to 7: "Strongly agree").

To validate our conceptual and measurement models, we interviewed six subject matter experts (project management and PMIS professionals from different industries) and asked them to provide feedback on the model itself and whether the items were comprehensible, valid and complete. This led to a further modification of the model and the rephrasing of some items in the item pools. To further improve the construct validity and conciseness, we undertook Q-sorting (Anderson and Gerbing 1991) and item ranking (similar to Davis 1989). A group of IS researchers and PM professionals was asked to match all the available items to the constructs in the model. Using the results of the item ranking, the number of items was then further reduced to arrive at an appropriate and concise measurement model. The Q-sorting and item ranking were undertaken in a single step by means of a spreadsheet-based tool. To test the survey instrument, we translated the items into an online survey. In addition to the construct operationalisations, we added a series of control variables. The controls pertained to the software product, the size of the organisation, its project management maturity and the survey participant's role and experience. In addition to filling out the survey, the online tool also allowed us to collect further participant comments. We asked a group of 115 PMIS users to participate in the pre-test and to comment on the survey instrument. The participant comments provided useful suggestions on how to improve the layout and phrasing of some of the items. We implemented the causal model in SmartPLS (version 2.0 M3) and calculated the model parameters with the pre-test data to evaluate the model's validity and explanatory power (see section 5 for the results).

# 4 CONCEPTUAL MODEL

## 4.1 Model Constructs

Not only is the DeLone and McLean ISSM (2003) closely related to our research questions, we also chose it because of its widespread adoption and validation. It has become the dominant model of IS success research and the causal relationships postulated by the model have been confirmed in many studies (Urbach et al. 2009b). The common use of the model has also led to many validated construct operationalisations. We felt that several modifications and additions were necessary to sufficiently address our research questions and reflect our hypotheses. DeLone and McLean's (2003) original operationalisation of *system quality* (adaptability, availability, reliability, response time, usability) was focused more on a system's technical properties. Our qualitative interview pre-study had shown that the IS success model's *system quality* construct was not sufficiently differentiated to reflect PMIS success dimensions. We therefore decided to split *system quality* up into three distinct constructs: *usability, functional quality* and *technical quality*.

Owing to the large number of activities subsumed in or related to project management (Project Management Institute 2004), modern PMIS have to cover a wide functional spectrum. Nevertheless, individual products usually only provide a subset of these functions. Furthermore, there are many different PM techniques (White and Fortune 2002), of which only some are fully supported by one particular system. Exemplary for software development projects, some systems are optimised for a waterfall-type development model, while others provide support for agile, iterative development models. In addition to its technical quality, users might therefore perceive an IS as fitting for their work environment (Sun et al. 2009). If the PMIS does not or does not fully support the internal processes or project standards, its *use* and *user satisfaction* might be negatively influenced. To account for this dimension, we introduced the new construct, *functional quality*. The operationalisation of *functional quality* also takes into account that PMIS have to adapt to the context of individual projects. Since this is a distinctive characteristic for this class of information systems and therefore no operationalisation was available in literature, we developed the survey items for this construct with the help of expert interviews.

| Construct | Definition | Items adapted from |
|---|---|---|
| *Information quality** | Information is of high quality if it fulfils the user's requirements with regard to completeness, usefulness, up-to-dateness, and intelligibility. | (Bailey and Pearson 1983; DeLone and McLean 1992; DeLone and McLean 2003; King and Epstein 1982) |
| *Usability*** | The *usability* construct is based on general ergonomic principles which apply to the design of information system interfaces. Systems with good usability do not require unnecessary inputs, work according to user expectations, give meaningful responses and provide the user with an appropriate level of control. | (ISO/TC159/SC4/WG5 2006) |
| *Functional quality*** | The functional quality consists of measures describing the PMIS functionality's alignment with the users' requirements. High functional quality implies that the users find that the functionality supports their project management role, processes and methods in general and in the context of their last project. | Expert Interviews |
| *Technical quality** | Technical quality resembles the construct *system quality* in the revised DeLone and McLean model. It reflects the PMIS technical properties of responsiveness, availability, speed and error-free operation. | (DeLone and McLean 2003) |
| *Service quality** | This construct includes measures of the overall support delivered by the service provider. In the context of PMIS, this success dimension covers the aspects responsiveness, reliability, empathy and competence. | (Urbach et al. 2009a) |
| *Use*** | This measures the perceived use of the PMIS. To obtain a differentiated picture of the system usage for different PM tasks, we use the project management areas as a basis, as codified by the PMBoK. | (Almutairi and Subramanian 2005; Project Management Institute 2004) |
| *User satisfaction** | User satisfaction represents the user's affective attitude towards using the PMIS. In combination with the actual use, user satisfaction is paramount in the evaluation of information system success. The construct evaluates the system's perceived adequacy, effectiveness and efficiency. | (Almutairi and Subramanian 2005) |
| *Individual benefits*** | This construct summarises benefits that can be gained by users completing their own tasks. These benefits include increased transparency, time saving and improved resource utilisation. In addition, the following questions' results were measured: Does the system draw the user's attention to important information? Does it increase the overall control over PM processes? Does it improve the user's performance regarding project management roles? | (Almutairi and Subramanian 2005; DeLone and McLean 1992; DeLone and McLean 2003) |
| *Workgroup benefits*** | Projects are usually a team effort. Common benefits mostly reflect individual benefits and understate the advantages on a workgroup level. Therefore, we decided to measure the improved communication within the team, increased meeting efficiency as well as the improved delegation and tracking of tasks by means of a separate construct. | Expert Interviews, (Ishman 1998), (Myers et al. 1998) |
| *Organisational benefits*** | Organisational benefits are realised on the organisational level. These include the ability to create better products, increase customer satisfaction, productivity, time-to-market and revenue. Organisational benefits of PMIS are also faster and more comprehensive in achieving goals. | (Bradley et al. 2006; DeLone and McLean 1992; DeLone and McLean 2003) |

*: reflectively measured construct; **: formatively measured construct

*Table 1. Constructs with definitions and item sources*

Usability is only a single metric in the original ISSM construct *system quality*. However, the pre-study interviewees unanimously mentioned usability as the most important factor for the use of PMIS. We also subscribe to the view that usability is more than the ease of use of individual interfaces. It is a rather distinct quality of a software system (Bias and Mayhew 1994). Therefore, we included *usability* as a separate construct with more sophisticated metrics. The measurement model was derived from the ISO standard for software system usability (ISO/TC159/SC4/WG5 2006). It has been shown to be difficult to measure *organisational benefits* (e.g., Gelderman 1998). Nevertheless, we believe that projects' and project management's importance on an organisational level (e.g., in organisational change and R&D) necessitate the inclusion of *organisational benefits* as a distinct construct (Myers et al. 1998; Whittington et al. 1999).

### 4.2 Model and Hypothesis

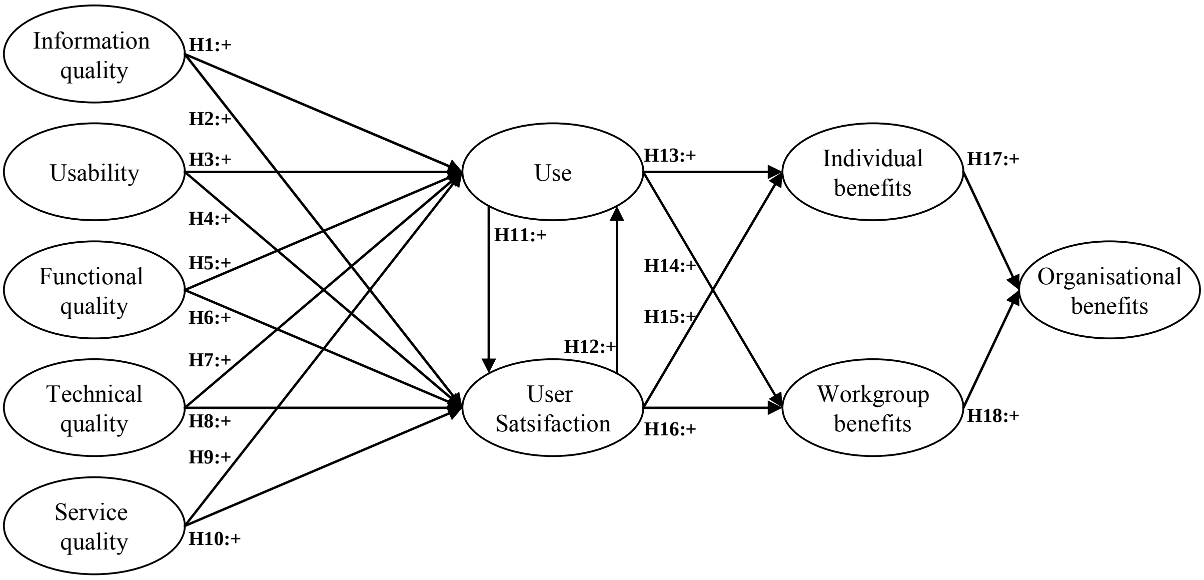


*Figure 1. The conceptual model*

With the constructs and their measurement models in place, we can now proceed to create hypotheses concerning the causal relationships and effects between them. Our conceptual model to explain PMIS success is depicted in figure 1. Our annotated hypotheses are:

**H1-H10**: *Information quality*, *functional quality*, *usability*, *technical quality* and *service quality* all have a positive effect on both the *use* of PMIS and the *user satisfaction*. (*Information quality* and *service quality* have both been part of the revised ISSM and we adopted the respective hypotheses. Since *usability*, *functional quality* and *technical quality* can be regarded as extended replacements of the original *system quality* construct, we also expect them to have the same positive impact.)

**H11, H12**: *Use* and *user satisfaction* have a significant positive effect on each other. (Only users of a system can be satisfied with it. In addition, increased satisfaction will probably lead to increased use.)

**H13-H16**: *Use* and *user satisfaction* both have a significant positive effect on *individual benefits* and *workgroup benefits*. (Use of a system enables users, workgroups and organisations to reap the benefits of a PMIS. *User satisfaction* should further increase those benefits, also mediated through *Use*. )

**H17, H18**: *Individual* and *workgroup benefits* have a significant positive effect on *organisational benefits*. (We do not believe that use and user satisfaction directly impacts organisational benefits, the effect is mediated by *individual* and *workgroup benefits*.)

### 4.3 Controls

The users and the usage contexts of PMIS are rather heterogeneous. To identify any distortions in the data due to this heterogeneity, we include a wide range of control variables in the survey instrument (table 2). The controls apply to the individual user, the project type (IT, construction, etc.) typically managed by the user and the organisation in which the system is in use. We also identify the actual software used as primary PMIS, i.e. the application which is used for most PM related tasks.

| Level | Controls |
|---|---|
| *Individual* | Age, gender, computer use intensity, PM competence/experience/education, PMIS knowledge, PM role |
| *Organisational* | Industry, number of employees, project type, number of projects, PM software product, PM maturity |

*Table 2. Control variables*

## 5 MODEL VALIDATION

Modifications to existing construct measurement models and the introduction of new constructs made an extensive validation phase necessary (Churchill 1979). The validity aspects we considered were: content validity, construct validity, convergent and discriminant validity as well as reliability (Straub et al. 2004). Prior to validation, we specified the nature of our construct measurement models as reflective or formative (see Table 1 for results) by following the decision rules proposed by Jarvis et al. (2003). Besides ensuring correct statistical results (Petter et al. 2007), this is also necessary to choose the correct validation heuristics. In order to perform additional, quantitative validity tests, we conducted a pre-test of the finalised survey tool. From the 115 project management practitioners invited to answer the survey we obtained 45 complete survey data sets, which we used to estimate the structural equation model based on our conceptual model using SmartPLS (version 2.0 M3).

### 5.1 Content Validity

Since most of our model's constructs were adapted from the literature, we expected the content validity to be high. Furthermore, in our pre-study interviews with PM experts, we discussed constructs and measurement models in respect of both the reflective and formative measures. Regarding the reflective measures, we asked them whether they thought the items conceptually matched the construct; concerning the formative measures, we inquired whether the items were sufficiently exhaustive to fully describe the measured construct (Rossiter 2002). The expert input prompted the aforementioned split of *system quality* and minor changes to item wordings.

In addition, we conducted a combined Q-sorting (Anderson and Gerbing 1991) and item ranking (similar to Davis 1989). We asked a group of eight judges, who were either IS researchers with project management experience or project management professionals, to use a spreadsheet-based tool which allowed them to, firstly, map items to constructs and, secondly, rank the items in terms of their relevance with regard to their mapped construct. We discarded all items with an item placement ratio (placements as expected/overall placements) lower than 0.5. The item rankings were then used to reduce the number of items in the models to a minimum of four.

### 5.2 Construct Validity

We quantitatively assessed the construct validity using the guidelines provided in Chin (1998) as well as Fornell and Larker (1981). The recommendations are provided in brackets following our values. Unless noted otherwise, the criteria below are only applicable to reflective measurement models.

**Reliability**: To ensure that the items of the measurement models were consistent internally, we looked at the composite reliability (CR) of all the constructs. Since CR is above 0.9 (*>0.7*) for all constructs, the measures are reliable (Lewis et al. 2005). Reliability can also be determined by evaluating the loadings of items to their respective construct. Once more, the loadings of all the standardised measures were above 0.7 (*>0.7*) and therefore sufficiently high.

**Convergence**: Convergence is essential for reflectively measured constructs to ensure that all items pertain to the same theoretical construct. The main indicator of convergence is the average variance extracted (AVE), which compares the amount of variance captured by a construct with the error. The AVE of all the constructs in our model is above 0.60 (*>0.5*). The loadings of all the items are also significant ($\alpha$=0.05). These indicators also lead us to conclude that all reflective measurement models are unidimensional.

**Discriminance**: All constructs should be clearly differentiated. To ascertain their discriminance, we compared the loadings of all the items on their constructs with cross-loadings on other constructs. All loadings were more than an order of magnitude larger than their cross-loadings to any other construct (Gefen and Straub 2005). As further evidence for their discriminance, the square root of the AVE of all the constructs was higher than the respective construct's correlation with other constructs on their level.

The formative constructs used in this study were only evaluated in terms of construct validity by means of evaluating their weights. We did not employ advanced techniques such as the vanishing tetrad analysis (Bollen and Kwok-fai 2000). The weights of some *use* and *usability* items were below 0.1 and are therefore candidates for deletion (Diamantopoulos and Winklhofer 2001). Since the *use* dimension was operationalised by means of the Project Management Body of Knowledge areas of project management (Project Management Institute 2004), the deletions would result in a deviation from the construct's literature foundation and should therefore be considered very cautiously. We decided to keep the construct intact for our survey purposes. Overall, we have no indication that any of the constructs are invalid. Judging from the $R^2$ values we estimated from the pre-test sample (*use*: 0.602, *user satisfaction*: 0.708, *individual benefits*: 0.494, *workgroup benefits*: 0.429, *organisational benefits*: 0.622), the model also has high explanatory power. Owing to the small sample size, we did not perform an extensive analysis regarding significance and larger, less biased samples could, of course, still change the picture.

## 6 RESEARCH IN PROGRESS AND LIMITATIONS

Since the sample size during the validation process was too small to obtain stable results, we have to extend the sampling to a larger number of project management information system users. We consequently contacted vendors in the PMIS market to obtain contact with their customers. Moreover, we will be able to address PMIS users in a pharmaceutical company (approx. 500 users) and an automotive supplier (approx. 300 users). Thirdly, we will invite the members of the German Association of Project Management (GPM) by means of an e-mail newsletter (reaching several thousands). This data collection strategy will result in a non-probability convenience sample. Although such a convenience sample might be less representative, we are confident that this will be offset by the higher response rate within sub-samples and higher overall number of responses. After collecting the data, we will again ensure statistical, internal, external and construct validity by using appropriate measures as described by Straub et al. (2004). This will provide us with additional information regarding the quality of our survey instrument. More importantly, we will be able to identify the key success factors for the realisation of benefits from a PMIS.

As stated above, the non-probability sampling strategy could negatively affect the generalisability of the findings (Smith 1983). This makes it even more important to carefully evaluate the control variables to ensure the sample is sufficiently heterogeneous. The survey will be an online one, which adds the risk of low response rates, which could, in turn, further impair the representativeness of the response (Cook et al. 2000). The non-response bias could lead to distortions in the sample. Nevertheless, the use of an online tool has the advantage of providing us with relatively simple means of isolating late responders and comparing them with early responders. This will help us estimate the effect of non-response bias (Armstrong and Overton 1977).

A sample collected with our survey instrument contains data of nested entities: users within workgroups and workgroups within organisations. Thus, it could be deemed more appropriate to employ multi-level analyses (Hofmann 1997). However, our data collection and sampling strategy does not allow for the reliable mapping of individual cases to workgroups or organisations. Therefore, the statistical analysis is limited to one-level approaches, such as structural equation modelling. The measures only reflect PMIS users' subjective perceptions. It has been shown that this could especially affect workgroup and organisation-level measures' validity. Users find the items of *organisational benefits* construct particularly difficult to judge, therefore the benefit constructs' validity could be problematic (Gelderman 1998).

# 7 CONCLUSION

The survey instrument presented in this paper will support research and practitioners alike in evaluating the success of a project management information system's introduction into an organisation. Using a rigorous development process, we created a model with high explanatory power and a valid measurement model. From a theoretical perspective, we amended the ISSM to accommodate a more differentiated view of a system's quality. In addition to the rather technical perspective of the DeLone and McLean model, we incorporated usability and functional quality as influences on the use of and satisfaction with a system. The individual impact has been replaced by three benefits constructs for the individual, the workgroup and the organisation using the system. If the constructs and operationalisations prove to be as valid and reliable and the explanatory power as high as the pretest promised, we hope the amended model will also be helpful to research on other classes of informations systems.

While the high impact of the PMIS's usability was predicted by the subject matter experts in our pre-study, the strong effect of information quality versus the rather weak effect of functional quality is surprising. If the effect sizes can be confirmed in the following study, this could lead to an improved PMIS introduction process for practitioners. Thereafter, the current practice of focusing on the system's functions should be revised and attention should be directed towards the information managed in a system.

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