Revista de Gestão da Tecnologia e Sistemas de Informação
Journal of Information Systems and Technology Management
Vol. 7, No.2, 2010, *p.281-310*
ISSN online: 1807-1775
DOI: 10.4301/S1807-17752010000200003

A COMPARISON OF ERP-SUCCESS MEASUREMENT APPROACHES

Stephan A. Kronbichler
University of Health Sciences, Austria
Herwig Ostermann
University of Health Sciences, Austria
Roland Staudinger
University of Health Sciences, Austria

ABSTRACT

ERP projects are complex purposes which influence main internal and external operations of companies. There are different research approaches which try to develop models for IS / ERP success measurement or IT-success measurement in general. Each model has its own area of application and sometimes a specific measurement approach based, for instance, on different systems or different stakeholders involved. This research paper shows some of the most important models developed in the literature and an overview of the different approaches of the models. An analysis which shows the strengths, weaknesses and the cases in which the specific model could be used is made.

Keywords: ERP, success, measurement, information system, review

1.INTRODUCTION

An ERP system is an integrated, configurable and customizable information system which plans and manages all the resources in the enterprise, streamlines and

---

Recebido em/*Manuscript first received*: 22/11/2009 Aprovado em/*Manuscript accepted*: 08/04/2010
Endereço para correspondência/ *Address for correspondence*

Stephan A. Kronbichler, Junior Researcher, University of Health Sciences, Medical Informatics and Technology, Oberndorf 50d, 6341 Ebbs. Tel.: 0043/664/8159748. E-mail: Stephan.Kronbichler@umit.at

Herwig Ostermann, University of Health Sciences, Medical Informatics and Technology, Eduard Wallnöfer Zentrum 1, 6060 Hall in Tirol, Austria, Department for Human and Economic Sciences. Fax. No.: +43 (0)50 8648 67 3880.E-mail: Herwig.Ostermann@umit.at

Roland Staudinger, University of Health Sciences, Medical Informatics and Technology, E-mail: Roland.Staudinger@umit.at

ISSN online: 1807-1775
Publicado por/*Published by*: TECSI FEA USP – 2010

incorporates the business processes within and across the functional or technical departments in the organization (She and Thuraisingham, 2007). ERP systems consist of different modules which represent different functional areas and they offer integration across the entire business, including Human Resources, Accounting, Manufacturing, Materials Management, Sales and Distribution and all other areas which are required in different branches (Davenport, 1998). ERP supports a process-oriented view of the enterprise and provides standardised business processes and real-time financial and production information for the management (Nah and Delgado 2006; May, 2003).

There are not only benefits that can be achieved from an ERP system implementation; there is already evidence of failure in projects related to ERP implementations which are found in the literature (Davenport, 1998). Competitively and technically, implementing ERP is a must do, but economically there are costs which are difficult to justify and it is difficult to implement a long lasting business advantage (Willcocks and Sykes, 2006). An investment in ERP represents a significant commitment of resources and it has a dramatic effect on all operational aspects of a business (Nicolau, 2004).

Business needs are changing rapidly and new requirements are often influencing business processes. Because of the new business needs which are coming up the company which wants to hold up or achieve competitive advantage has to react immediately and the quality of the adopted or implemented solution is often poor (Kronbichler et al., 2009). According to different studies, a lot of ERP projects do not reach the expected results or lead to the failure of the project. The study of Cooke et al. (2001), for example, listed 117 companies which implemented ERP and had the following results: 25 percent of all the projects were out of budget, 20 percent of the projects were abruptly discontinued for various reasons, and 40 percent of the remaining 55 percent stated that they did not reach the defined goals within one year after the official project ended. Although some of these problems arise from technical aspects, the majority of these problems result from management, social and organisational issues within the companies. For a successful ERP implementation, these issues must be considered because there are a lot of challenges for organisations during ERP projects. Businesses are expected to change their business processes to fit the standardised business processes from the ERP-solution selected and, as a result, to fully benefit from the ERP (Nah et al., 2003). Project management often has a technical focus and nontechnical issues are ignored. The project management only monitors if the project is in time, in scope and in budget.

A lot of research in critical success factors (CSF) in ERP-implementations or ERP-projects has been done (Kronbichler et al., 2009, Esteves-Sousa and Pastor-Collado, 2000, Holland and Light, 1999, Nah and Lau, 2001, Sumner, 1999) but there are a few publications which show the different approaches of ERP-success measurement and the advantages and disadvantages of these investigations. A review of different success measurement approaches is necessary to oppose the CSF and the success of the running system for further research. This ongoing research paper analyzes the different aspects and possibilities of ERP and information system success measurement and it concentrates on the post implementation phase, summarizes the different approaches and shows how relevant these approaches are for the measurement of ERP-success. It

can be used as a basis for decision support during the selection of a suitable success measurement model for a specific research question in the field of ERP-success measurement.

The purpose of this research is to identify possibilities of success measurement and to show which of these possibilities turned out to be of importance in order to provide indispensable information for further ERP-research.

The main steps for the research study are:

- Literature review related to success measurement in ERP / Information system projects
- Investigate the relevance for the measurement of ERP success and list the main models identified
- Point out the strategic importance of success measurement
- Build an overview which assists practitioners and researchers in selecting a success measurement model

Through an extensive review of the existing publications in the field of success measurement different models were identified. After finishing the literature review, the models were examined. In a third step, the relevance of the models for different use cases is shown.

2.ERP SUCCESS MEASUREMENT

Research Methodology

The search term for appreciable publications was “success” and “measure” in combination with “information system” or “ERP”. The second search term for important publications for this research paper was “enterprise systems success” which is often used in the literature. Every result was analysed through a review of the abstract. The findings of the first step of the literature review were analysed and further publications in the subject of the measurement of success within information systems and ERP-systems were found because of the references of the analysed publications.

Later, the findings of the publications were analysed and the current state of the field was built through an investigation of the different success measurement models / possibilities which were found in the literature. At the end of the paper different approaches were made which ensure a support for the selection of an appropriate success measurement model.

Success and Quality

Success is a dependent variable of the reached quality level. If the quality of the ERP-system running is poor, the success will be also poor in most cases.

According to the ISO 9000 2005 standard, the quality of something can be

determined by comparing a set of inherent characteristics with a set of requirements. If those inherent characteristics meet all the defined requirements, high or excellent quality is achieved. If those characteristics do not meet all defined requirements, a low or poor level of quality is achieved. By linking quality to requirements, ISO 9000 argues that the quality of something cannot be established in a vacuum and quality is always relative to a set of requirements (Praxiom Research Group Limited, 1997). The success or failure of information systems is relative too and must be measured in relation to the expectations of the organisation that implements the system (Curlee and Tonn, 1987).

Although success is complex and difficult to measure, researchers are making efforts in doing so. Most of the practical measurements focus on delivering a functional IS product within certain economic and temporal constraints. A system must first be accepted to be used and that should increase the probability of system success (Behrens et al., 2005). A lot of research has been focused on defining factors and measures that should capture the characteristics of an information system but such factors might not capture the intangible or indirect value generated by the according system (Ding and Straub, 2007). It is reasonably easy to evaluate tangible implementation costs, e.g. software license, hardware, consultancy, and training, but other intangible costs are much more difficult to measure and evaluate (e.g. productivity dip) (Hedman and Borell, 2005).

3. SUCCESS MEASUREMENT APPROACHES

In the following section of this paper some models for success measurement are listed and explained. It is an overview of the existing approaches without an extensive explanation of each framework. The different measurements which are used at the most detailed level of the success measurement of the models are not enumerated, because this is not necessary for the understanding and the purpose of the models themselves.

The DeLone McLean I/S Success Model

The most cited model for success measurement in the field of information systems is the DeLone and McLean (DeLone and McLean 1992, DeLone and McLean, 2002, DeLone and McLean, 2003) model which moved to a user centred approach when trying to judge overall IS success. The DeLone and McLean model consists of six interdependent measurements of success. System quality, information quality, use, user satisfaction, individual impact and organisational impact are the main measurement dimensions.

DeLone and McLean had different purposes when they were writing their publication in 1992. They wanted to organize and summarize management information system research related to defining the dependent variable, to measuring progress on defining the dependent variable and to improving the information systems research practice (DeLone and McLean, 1992). The methodology they were using to build the

model consisted of the following main steps:

- Literature review
- Collection of IS Articles from 1981 to 1988
- Build a framework / model for organizing success measures
- Definition of empirical measures which are grouped into six success categories

This model provided a comprehensive taxonomy on IS success and identified over 100 IS success measures during the analysis of the collected articles (Elpez and Fink, 2006).

In 2002 DeLone and McLean published a reformulated IS-success model which offered the addition of service quality and the collapsing of individual impact and organizational impact on net benefits (DeLone and McLean, 2002, Ding and Straub, 2007). The change of the model was based on alterations in the role and management of information systems and on research contributions since publishing their original paper. The “use” was replaced by “Intention to use”, which is an attitude, whereas “use” is behaviour; this new part of the model may resolve some of the process versus causal concerns that Seddon (1997) raised . But attitudes, and their links with behaviour are difficult to measure and many researchers may choose to keep “use” but with a more extensive understanding of it. The new model shows that “use” must precede “user satisfaction” in a process sense, but positive experience with “use” will lead to greater “user satisfaction” in a causal sense. That’s the reason why increased “user satisfaction” will lead to increased “intention to use,” and, thus, “use.” As a result, “net benefits” will occur. The lack of positive benefits can lead to decreased use and possible discontinuance of the system or of the whole IS department itself (e.g. outsourcing) (DeLone and McLean, 2003). The new construct “Net benefits” is the collapsing of Individual and Organisational Impact which were mentioned in the original model of 1992. This was necessary to broaden the impact of the information system also depending on the context in which the model was used (DeLone and McLean, 2003, Wu and Wang, 2006).

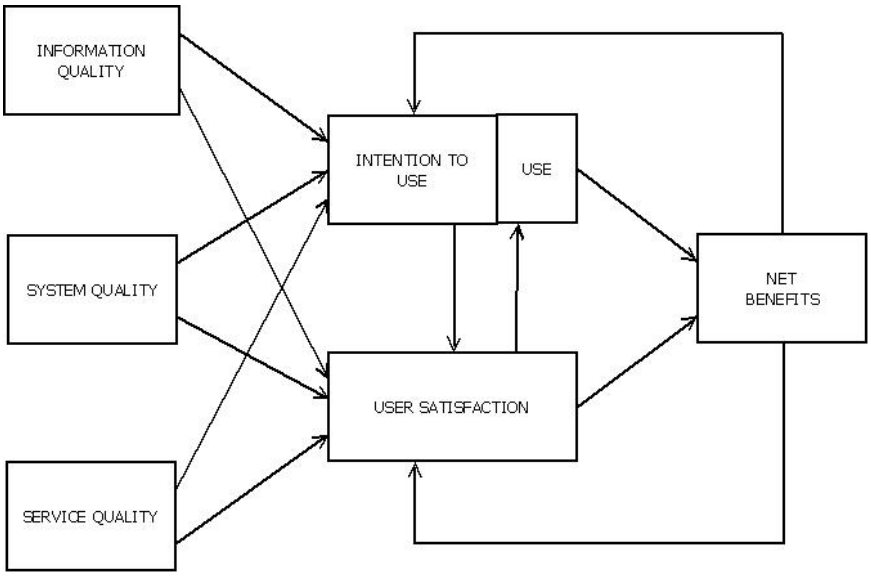

Figure 1: Updated IS Success Model of (DeLone and McLean, 2003)

The arrows between the 6 Dimensions of the DeLone & McLean model show the relations and interdependencies between the dimensions. System quality, for example, influences the Intention to use, Intention to use influences the user satisfaction and, as a result, the net benefits occur. If the system quality is poor, the net benefits are poor too. The 6 dimensions are the dimensions DeLone and McLean identified during their research when they were investigating the dependencies of information systems success.

The Gable et al. model

Gable et al. (2003) made an exploratory inventory survey which was used for model building. They built a model which was used for enterprise system success measurement approaches – the "A Priori Model". The "A Priori Model" was using five constructs and forty-two sub-constructs. The aim of the test of the "A Priori model" originally showed that the ERP success depends on the size of the organisation (Myers et al., 1997).

The Delone and McLean constructs and measures were used as the basis of the starting ES success model and were synthesized with the associated measures from Sedera et al. (2003). The constructs/ measures of the Delone and McLean model provided a holistic view across the different roles within the organization and provided a detailed categorization of success dimensions. A main difference to the DeLone & Mc Lean model is that the construct use was omitted from the *a priori* model. The mapping exercise of the 2 different measures facilitated identification and inclusion of other, new measures related to ES. Therefore some measures were considered unsuitable and were omitted from the a priori model. The build model was tested for its validity and the validity of four model dimensions and their convergence in a single higher-order

phenomenon, enterprise system success, were shown. The revised model is the result of Gable et al. research. It has four quadrants, individual impact, organisational impact, information quality and system quality which are related dimensions of the multidimensional phenomenon: enterprise system success (Gable et al., 2003).

The main differences to the DeLone and McLean model are:

- it is a measurement model and does not purport a causal/process model of success
- the construct use is omitted
- satisfaction is treated as an overall measure of success (no explicit dimension for user satisfaction)
- new / additional measures were added to reflect the contemporary IS context and organizational characteristics (Gable et al., 2003)

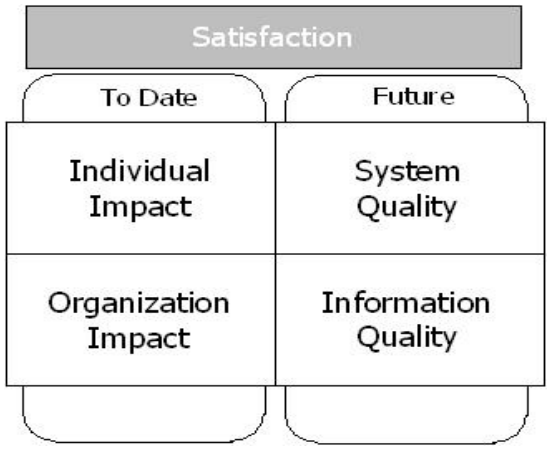

Figure 2: The Revised Model of (Gable et al., 2003)

Individual impact means the impact of the system on the individual working with the system, e.g., decision effectiveness or individual productivity. Organisational impact measures the impact of the system on the organisation, e.g,. organisational costs or staff requirements. System quality consists of measures like ease of use, flexibility or data accuracy. Information quality on the other hand consists, e.g., of timeliness, relevance or importance of the information worked up.

The Gable et al. model can be used for measures at a certain point of time, a snapshot of the organisation's experience. The impact dimensions are an assessment of benefits which are caused by the system (in a negative or positive way). The quality dimensions of the model show the future potential. Together, the four dimensions reflect a complete view of the enterprise system and the success reached (Gable et al. 2003).

The extended ERP Systems Success measurement model

(Ifinedo, 2006) extended the dimensions of success proposed by Gable et al. (2003) because of the growing body of knowledge in this research field. The author found through literature review and interviews that ERP systems success measurement models might be limited because 2 important dimensions may not be considered. One new dimension which was added to the model was the Vendor/Consultant Quality because the result of empirical evidence revealed that firms tend to associate the role and quality of the providers of their software with its overall success of the organization (Ifinedo, 2005, Ifinedo and Nahar, 2006). ERP-projects are very complex and take a lot of time, that's why competent partners are needed. A know-how transfer and mixture between internal and external staff is necessary to manage it. Vendor / consultant quality measures the influence of external quality on the ERP-systems success. Vendor and consultant are grouped together because they represent an external source in the model. Infinedo (2006) argued that the client will be in a better position to use the acquired software efficiently and effectively in achieving organizational goals when an arrangement between externals and the implementing firm exists. When this is the case, success with the software increases. Typical measures for this dimension are technical support provided, relationship with the organisation or credibility and trustworthiness.

The author considered the research of Myers et al. (1996) who argued that any IS success model should incorporate workgroup impact. Workgroup impact, the second added dimension, in the notion of Infinedo (2006) means that "workgroup" encompasses sub-units and/or functional departments of an organisation. According to Ifinedo (2006) workgroups like teams or groups can contribute a lot to the success of an ERP-project. The author refers to CSF research, which showed that workgroup impact is one of the most important success factors. Typical measures for this dimension are improvement of interdepartmental communication or organizational-wide communication.

Laterm Ifinedo (2006) made an attempt at replicating, validating and extending the model. An additional finding was that System Quality and Organizational Impact were found to be perhaps the two most important dimensions for ERP systems success.

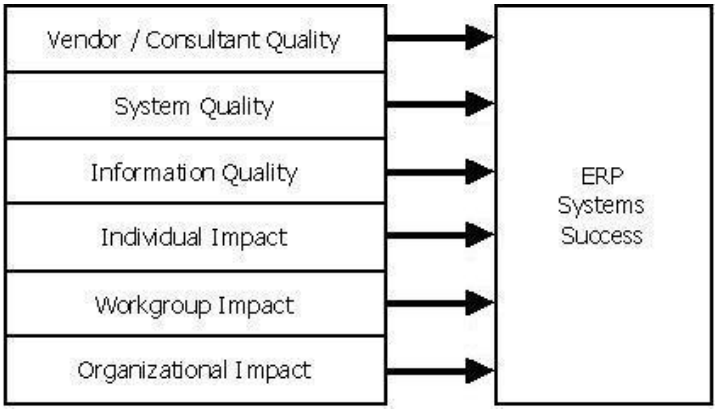

Figure 3: The Extended ERP Systems Success Measurement Model of (Ifinedo,

2006)

The main differences to the Gable et al. model are the 2 additional dimensions vendor / consultant quality and workgroup impact. The Ifinedo (2006) model has nearly the same area of application as the Gable et al. (2003) model, but it provides a framework that allows to collect more comprehensive data influencing the ERP-systems success.

Markus & Tanis

Markus and Tanis (2000) tried to define success based on their observations of enterprise systems. According to the authors there are different phases characterized by key players, typical activities, characteristic problems, appropriate performance metrics and a range of possible outcomes. Each experience made with ERP is unique, and experiences may differ from company to company and from the specific point of view (Markus and Tanis, 2000). Markus and Tanis (2000) defined an enterprise system experience cycle with different phases and for each phase the publication includes a description, key actors, typical activities, common errors or problems, typical performance metrics and possible outcomes. Figure 4: **Adopted Enterprise System Experience Cycle of Markus & Tanis (2000)** shows how the success measurement model of Markus and Tanis works.

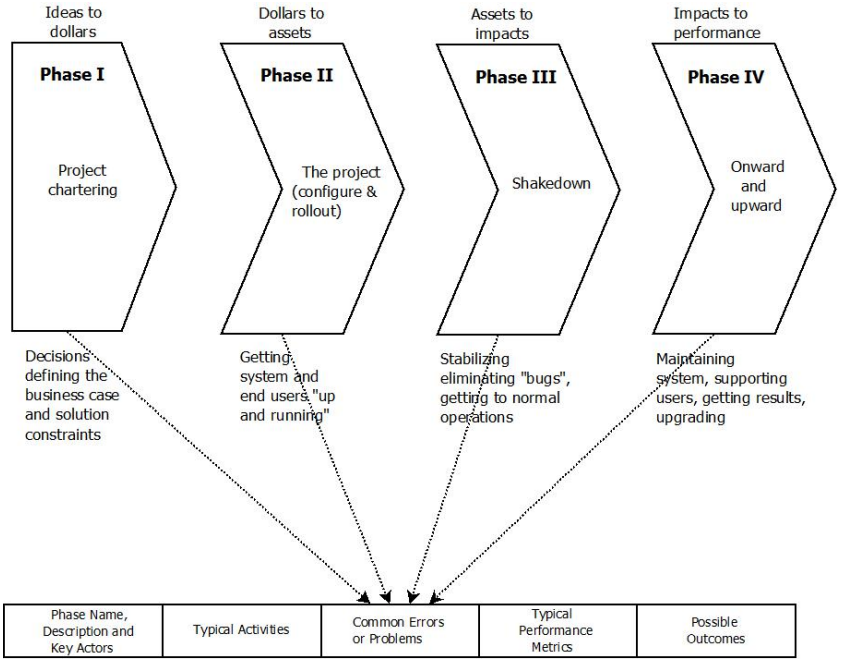

Figure 4: Adopted Enterprise System Experience Cycle of Markus & Tanis (2000)

The success measurement model of Markus & Tanis (2000) can be used for multiple success measurement approaches at different stages of an ERP-project. It provides the possibility to make plans and take actions if a result is not as good as expected and to get better results in the next phase because every outcome of a phase is influencing the next phase. At the end of the research of Markus and Tanis (2000) there is a table which shows "A Process Theory of Enterprise System Success" with the phases name, the successful outcome, necessary conditions, probabilistic processes and a recipe for success. The difference to other models is that this model provides a theoretical framework for analyzing retrospectively and prospectively, the business value of enterprise systems.

Ex-ante evaluation of ERP software

The main focus of the research is the ex-ante evaluation and the selection process of ERP systems (Stefanou, 2001). The difference to the other models which are part of this research is that all of the models (except the Markus and Tanis (2000) model) concentrate on an ex-post evaluation which concentrates on an evaluation of an existing system. According to Stefanou (2001) an ex-ante evaluation is necessary because of the fact that selecting an ERP is a long time commitment which is very costly too. The model of Stefanou (2001) is divided into 4 main phases which are demonstrated in Figure 5: Major phases of ERP-lifecycle (Stefanou, 2001).

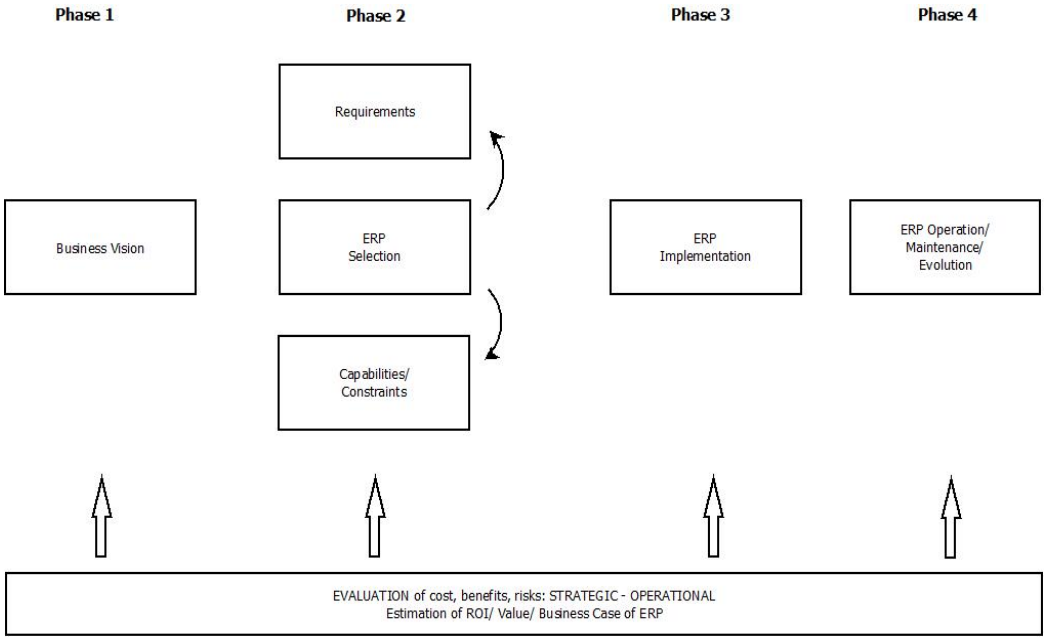

Figure 5: Major phases of ERP-lifecycle (Stefanou, 2001)

The first phase (Clarification of the business vision) considers the business vision as a starting point for ERP initiation/acquisition. Investments in ERP are strategic actions which have consequences for the company. For the selection of an appropriate system, a clear business vision is necessary because it has to be clear which aims the implementation of the new system should achieve and if the evaluated system enables it. The first part of the second phase (Comparing needs vs. capabilities) consists of the detailed examination and definition of business needs and of the company's capabilities and various constraints according to the ERPs functionality. That means that the decision, if the ERP can support the business processes of the company or if an adoption would be necessary, has to be made. Therefore, a list of the required technological changes for a successful implementation must be made. The constraints which are limiting the possibilities are classified into 5 categories: Technical, organisational, human, financial and time constraints. The second part of the second phase considers the selection of needed ERP modules and additional software which is necessary to handle the daily business. Additionally, an ERP product, vendor and support services evaluation should be made in this phase too. The implementing company has to decide if an all-in-one solution is a better choice than best-of-breed solutions. In the third phase of the Stefanou's (2001) ex-ante model costs and benefits arising from the ERP implementation project are estimated. The costs of consulting fees and the user training are only examples for some points the evaluators shouldn't ignore in this phase. The last phase of the suggested model is "operation, maintenance and evolution" which means that changes in the market and new business channels cause in updates or new releases of the implemented software. That means that after finishing the implementation project there is a continuous check necessary if the solution fulfils the needs of the business. This phase includes estimation of the costs and benefits which will arise in the future from operating, maintaining and extending the ERP system with additional functionality (Stefanou, 2001). The proposed framework of Stefanou (2001) shows how companies can evaluate a planned ERP-implementation project ex-ante. That means that it provides instruments to evaluate the future outcome and helps the management to decide the best way for the company. The framework guides the evaluator through all the important stages which must be considered when evaluating ERP systems because a simple evaluation based on ease of use, usefulness and involvement of end users, as it has been suggested by Montazemi et al. (1996) is not longer valid for complex systems like ERP.

Balanced Scorecard Approaches

The management of ERP Software consists of two main tasks-the implementation and the use of this comprehensive software afterwards (Rosemann and Wiese, 1999). The intention of the Balanced Scorecard is the supplementation of traditional financial measures with three additional perspectives – the customer perspective, the internal business process perspective and the learning and growth perspective (Kaplan and Norton, 1997). The Balanced Scorecard (BSC) can be used for evaluation of these tasks and afterwards for the strategic planning of the future development of the system based on the evaluation results (Rosemann and Wiese, 1999, Martinsons et al., 1999). There are two publications which investigate the usage of a BSC-approach for IS evaluation,

one of Rosemann and Wiese (1999) and another one of Martinsons et al. (1999). In this research the BSC approach of Rosemann and Wiese (1999) is demonstrated because the BSC approaches are very similar and they should demonstrate how a BSC can be used for ERP success measurement. Martinson's et al. (1999) BSC is not ERP specific; it's an IS BSC in general.

Rosemann and Wiese (1999) provided two different BSC approaches in their research. The first BSC approach is measuring the project performance and in addition to the classical perspectives (financial/cost, customer, internal process and innovation and learning), a fifth perspective, which represents the typical project management tasks, the project perspective was added to this BSC. The second BSC approach of Rosemann and Wiese, the operational BSC, which is more relevant for this research, is measuring the business performance and can be used for (continuous) controlling of the ERP software.

The operational BSC is shown in Figure 6: **The ERP operation Balanced Scorecard** (Rosemann and Wiese, 1999)

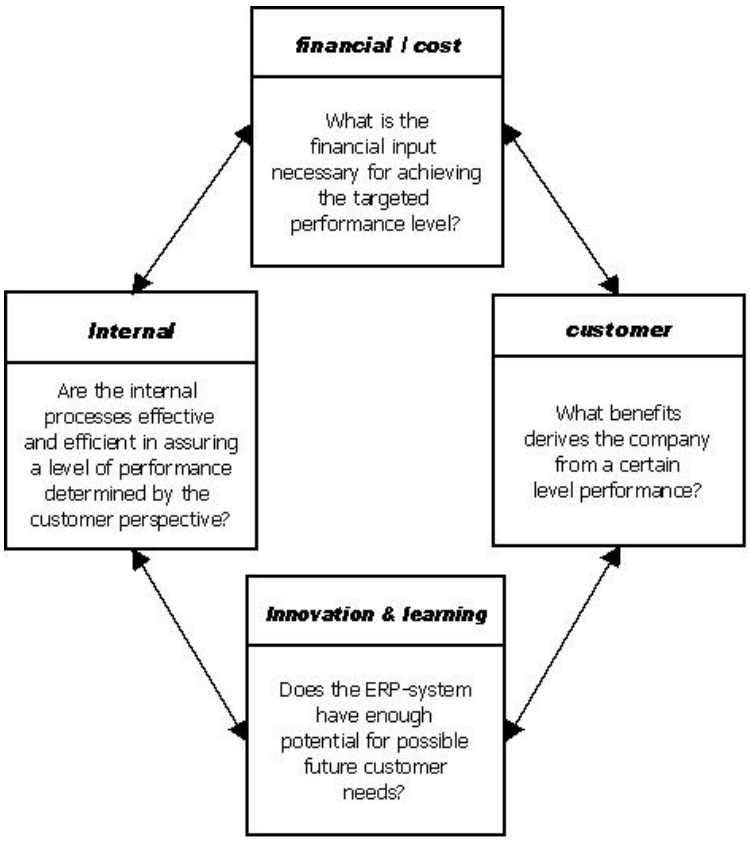

Figure 6: The ERP operation Balanced Scorecard

For the purpose of using the Balanced Scorecard to control the running of ERP

software, the four standard perspectives of the original model have to be adjusted to the specific object of an ERP system.

Financial Perspective

An ERP-system represents a capital investment which causes expenses as well as revenues. These expenses and revenues are not quantifiable in an easy way. But a financial follow-up is nevertheless required and can be usefully take on the form of a gap analysis concentrating on the actual expenses versus those expenses budgeted. According to Rosemann and Wiese (1999) the results of the financial perspective can help to identify poor performance. Negative deviations of actual training costs versus budgeted costs may indicate that the system's functions are not efficiently used by staff members. A continuous increase in external consulting expenses may point to deficiencies in the internal training staff's competence.

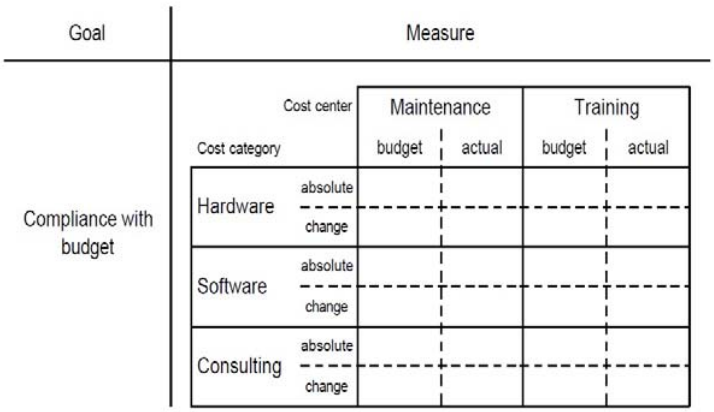

Figure 7: The financial perspective of Rosemann and Wiese (1999)

Customer Perspective

Rosemann and Wiese (1999) differentiate between employees directly dealing with the system and external business partners like suppliers, subcontractors and customers which are indirectly working with the system. For the purpose of measuring business performance, concentrating on internal users seems more adequate, since the system's effects on external partners are rather remote and indirect. There are 2 aspects which should be differentiated:

- The share of types of business processes covered by the system. An example for this is the retailing sector with business process types like "classical" retailing, third party orders, settlement, promotion and customer service.
- The share of total transaction volume handled by the system versus transactions performed outside of it needs to be considered.

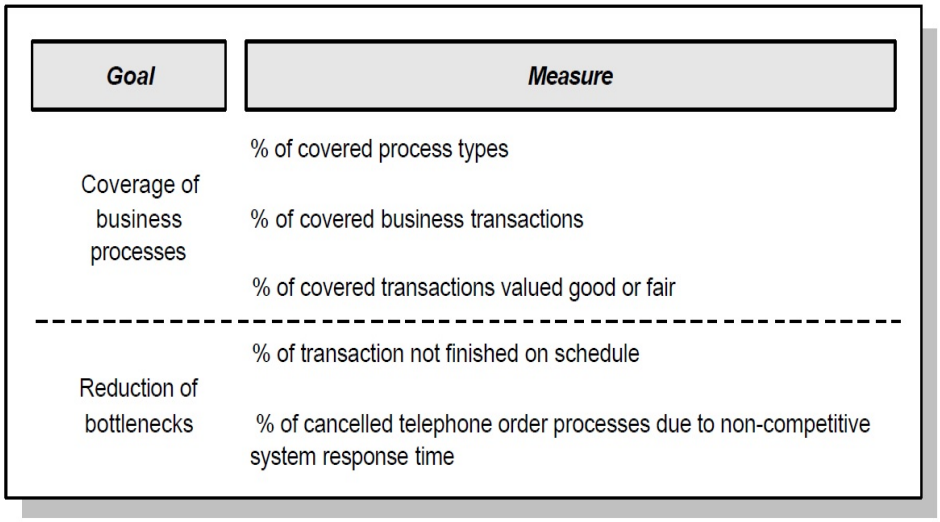

Figure 8: The customer perspective of Rosemann and Wiese (1999)

Because of the bottom-up approach, which is followed by Rosemann and Wiese (1999), measures should be designed so as to allow easy identification of bottlenecks connected with the system.

Internal Process Perspective

The internal process perspective focuses on the internal conditions for satisfying the customer expectations. These conditions can be grouped into processes needed for operating the system (Figure 9: The internal process perspective - operational view (Rosemann and Wiese, 1999)) on the one hand and those for improving and enhancing the system (Figure 10: The internal process perspective - development view (Rosemann and Wiese, 1999)). Essential measures for evaluating its internal processes are the number and type of trends in user complaints. Analysis of these measures should lead to a ranking of system defects by disutility to users. Further important are the bottlenecks which should be identified when measuring response time, transaction volume, and their respective evolution over time. These measures are early indicators of the need for capacity augmentation.

Goal	Measure
Reduction of operational problems	# of problems with customer order processing % of problems with customer order processing # of problems with warehouse processes # of problems with standard reports # of problems with reports on demand
Availability of the ERP-system	average system availabilty average downtime maximum downtime
Avoidance of operational bottlenecks	average response time in order processing average response time in order processing in the peak time average # of OLTP-transactions maximum # of OLTP-transactions

Figure 9: The internal process perspective - operational view (Rosemann and Wiese, 1999)

Goal	Measure
Actuality of the system	average time to upgrade the system release levels behind the actual level
Improvement in system development	punctuality index of system delivery quality index
Avoidance of developer-bottlenecks	average workload per developer rate of sick leave per developer % of modules covered by more than 2 developers

Figure 10: The internal process perspective - development view (Rosemann and Wiese, 1999)

The Internal Process Perspective can help to eliminate defects as well as to improve the system's present capabilities and introducing new functions. In order to evaluate the effectiveness of the enhancement process, standardised indices should be defined. For example the actual time needed for development compared to schedule. Or an index to measure the quality of the developed software.

Innovation and Learning Perspective

The innovation and learning perspective is dedicated to an examination of the company's ability to effectively make use of the ERP system's functions as well as to enhancement and improvement of the system. This ability depends on the know-how of personnel and entails including employee-centred measures covering both users and IT staff. A useful indicator for measuring this dimension is the level of training courses, measured by the amount of time or expenses spent. For system developers, there are specific measures like their type of formal qualification which can additionally be surveyed. Another important measure is dependence on external consultants which are often necessary for the implementation of an ERP system and ERP projects. However, the company desires a quick know-how to its internal staff in order to reduce its need and dependency for highly paid consultants.

Goal	Measure
Qualification	# of training hours per user # of training hours per developer qualification index of developer
Independency of consultants	# of consultant days per module in use > 2 years # of consultant days per module in use < 2 years
Reliability of software vendor	# releases per year # of functional additions # of new customers

Figure 11: The innovation and learning perspective of Rosemann and Wiese (1999)

Task-Technology Fit (TTF) construct as an indicator of ERP success

The Task-technology fit (TTF) theory has the main clear statement that IT is more likely to have a positive impact on individual performance and can be used if the capabilities of the IT match the tasks that the user must perform. It measures the acceptance with the 3 main influence factors: task, ERP (technology) and user. These 3 factors are influencing the acceptance of the system. ERP is viewed as a tool used by individuals carrying out their tasks. Tasks are the actions carried out to transform inputs into outputs. That means, for example, input is an order of a customer and output is the delivery of the specific article. Users use the technology to support them in performing of their tasks. Task-technology fit measures the degree to which a technology supports an individual in performing his or her portfolio of tasks (Goodhue, 1995). Smyth (2001) adopted the original model of Goodhue and Thompson (1995) and added 2 other accepted success indicators, Perceived usefulness, what Ives and Olson (1984) call

"aggregate organizational benefit" and "user satisfaction" what DeLone and McLean (1992) reported as a further important indicator of IS implementation success. The framework describes the match between the functionality provided by the ERP package, the tasks undertaken by the users of that package, and the skills and attitudes of the individual users. In the TTF ERP Success Model of Smyth (2001) TTF, perceived usefulness and user satisfaction are shown as the three constructs that are the most important indicators of ERP success.

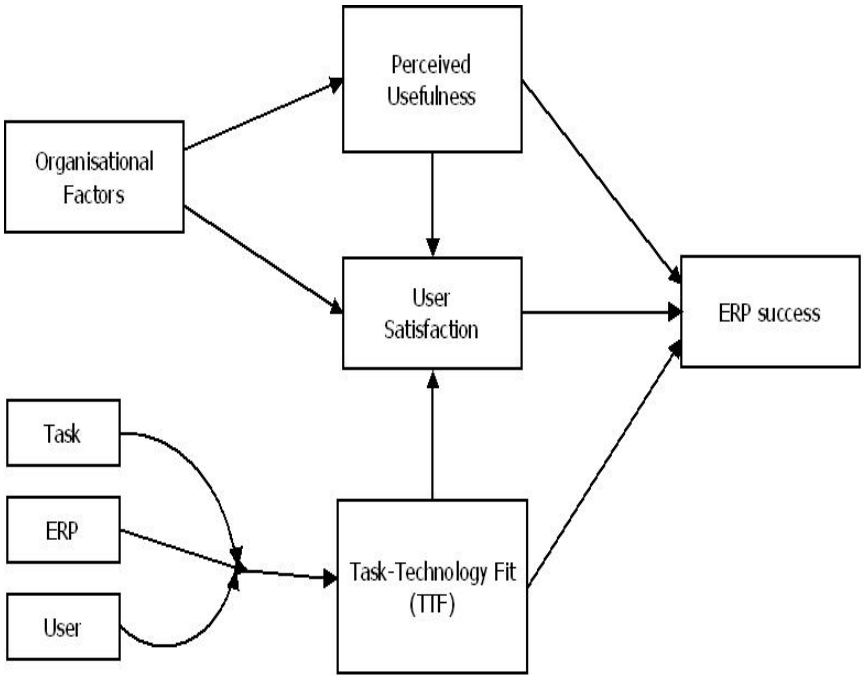

Figure 12: ERP success model from Smyth (2001)

In this model poor TTF would contribute to a low level of User Satisfaction, while poor TTF and low user satisfaction each would contribute to the lack of success of the ERP package. Perceived usefulness is influenced by organisational factors and that's influencing the user satisfaction in a direct and an indirect way. To use this model in practical use it is necessary to go through the publications which are the basis for this new framework (mentioned above).

Other Success Measurement Models

There are models which are very similar to existing models such as the research of Seddon (1997) or very specific for measuring only one aspect of IS success, like the research of Sedera et al. (2003) who studied the relation of the size of the organisation and the success achieved or Wu and Wang (2007) who investigated the key user's

viewpoint in success measurement approaches. The focus of this paper is to show the most important approaches of success measurement for IS / ERP systems, that's why only a selection of the probably most interesting approaches for future research in this field is shown. A lot of models arise from different research approaches but only a few have really new or alternative basic approaches which need to be considered in this research. One interesting aspect is the difference of some models identified. Some arising from the DeLone McLean model, others like the BSC models showed a new attempt when the researches were published. The TTF is interesting because of the alternative point of view which is concentrating on the fit of the system to the needs of the users / involved parties. That shows that every model discussed has a right to exist and a ranking according to the functionality / gained currency doesn't make sense.

4.COMPARISON AND AREA OF APPLICATION OF THE MODELS

In this section of the paper, the success measurement models which are mentioned above are investigated regarding the different use cases and the different dimensions of success measurement approaches in the field of ERP systems. That means that every model has specific strengths and weaknesses and for every practical success measurement intention different needs occur, which can result in different models used. The possible outcomes of success measurement differ on the intention the company has when using a success measurement framework in practice. Table 1 shows an overview of the different features of the investigated models which should help in selecting an appropriate model. Some of the models are ERP specific, others are concentrating on information systems in general and may need adoption when used for ERP success measurement. The dimensions were defined by the authors of this research. Therefore, some criteria which are interesting for the use of a model were investigated through the literature review. The first dimension on the y-axis is the "No of different perspectives" which means the number of the ranges in which the success metrics were defined. As mentioned above the DeLone & McLean model has the dimension "Service Quality" with some metrics which make the dimension measurable. "Suggested Measures" means that the authors who build the model in their research already defined measurement metrics for the dimensions of their model. The authors of some models, such as the IS Effectiveness Matrix, are only listing a few metrics which should help as an assistance for the defining of appropriate measures. The third dimension "Tested in practical use" shows if the model was already used for the evaluation of a IS / ERP and not only a theoretical construct. "Process model / Causal model" shows which type the model is. Process models often represent a networked sequence of activities or dimensions. Such models can be used to develop more precise and formalized descriptions of success measurement approaches. Causal models represent the causal interdependencies between the dimensions of the models. As mentioned above in the DeLone and McLean model "User satisfaction" is influencing "Use".

In the section following table 2 considers the stakeholders' interests and other dimensions of interest when selecting a model in daily business practice.

Criteria / Model	DeLone & McLean [DeLone and McLean, 1992], [DeLone and McLean, 2003]	Gable et al. model [Gable et al., 2003]	The extended ERP Systems Success Measurement Model [Ifinedo, 2006]	Markus & Tanis [Markus and Tanis, 2000]	Ex-ante evaluation [Stefanou, 2001]	ERP BSC [Rosemann and Wiese, 1999]	Task-Technology Fit (TTF) [Smyth, 2001]
No. Of Different Perspectives (dimensions / phases)	6	5	7	4 phases	5	4	8
Suggested Measures (the author proposes measures for each dimension of the success model)	Yes	Yes	Yes	Yes	Yes, but only examples which could be relevant in each phase	Yes	No
Tested in practical use (the model was testet / validated in a survey / questionnaire)	Yes	Yes	Yes	No	Yes	No (not this specific approach but e.g. [Darshana et al., 2001])	No
Process model / Causal model	Yes / Yes	No / No	No / No	Yes / No	No / No	No / No	No / Yes
Year of publication	1992 / 2003	2003	2006	2000	2001	1999	2001
Focus of the model	According to the authors the updated D&M IS Success Model can serve as a foundation for the positioning and comparing of IS empirical research. The original model was testet and validated by many researchers, that shows the importance of the model for IS success measurement. The DeLone & McLean model is useful for the success measurement when the causal / processual dependencies are important for the researcher or the company which is doing the measurement. The model can be easily adopted for the specific needs of success measurement (like E-Commerce success in [DeLone and McLean, 2003]) and that's necessary because every success measurement field needs specific metrics.	The Gable et al. Model is a "simple" approach for success measurement. It consists of 4 main dimensions which lead to the fith dimension, the "Satisfaction". There are no processual or causal dependencies between the dimensions. One main difference to the DeLone & McLean model is that the Gable et al. model doesn't explicitly consist of a dimension which considers the users because satisfaction is used as an overarching measure of success rather than as a dimension The Gable et al. model can be used for the success measurement without any processual or causal independencies between the dimensions. Additionally it consists of the most extensive and complete set of IS measures tested in a single IS success study.	This model is an extension of the Gable et al. Model and adds 2 dimensions. The Vendor/Consultant Quality dimension and the Workgroup Impact dimension. The model was extended after a literature review and a qualitative case study. The author of [Ifinedo, 2006] argued that the 2 dimensions are needed in the field of ERP success measurement, which is different from other IT implementations. This model focus on ERP systems success measurement and presents practitioners guidelines for assessing the success of their ERP software. The list of success measures could be helpful for companies when doing success measurement, evaluation or assessment.	The framework of [Markus and Tanis, 2000] focus on a process view of an ERP implementation project. There are different phases in which success measures and activities are common practice. This can be used for the measurement of the performance and to make a plan how to avoid possible negative outcome in a later phase. Therefore the authors defined "Successful Outcomes" for the different project phases and a according "Recipe for Success". The framework has its strengths during ERP implementation projects or large projects which pass through the defined project phases. It guides threw different phases with success metrics and outcomes and can be useful as a benchmarking of the actual progress and the discrepancy to the planned progress.	The research of [Stefanou, 2001] provides a framework of the key issues involved in the selection process of ERP software. It is divided in different phases which have different potential tangible and intangible costs, benefits and risks. This is different to the other models which concentrate on the success measurement / evaluation of an implemented system which is running in daily business. In this research an ex-ante evaluation framework is provided which additionally shows an overview of potential costs and benefits associated with ERP lifecycle phase.	This ERP-BSC shows how a b a BSC approach can be used at a strategic level to evaluate the implementation of ERP software. That is different to the origin of the BSC because only one process, the implementation process is controlled and evaluated. The new added perspective covers all the project management tasks which are needed for ERP implementation approaches. The main objective of the BSC, the transformation of visions into strategies, objectives and measures is also covered by the ERP-BSC. According to the authors of [Rosemann and Wiese, 1999] it should be used as an addition to specific implementation tools as it serves as a guideline and a permanent controlling tool for the evaluation of the entire project. The defined metrics are ERP project specific.	The purpose of TTF is to find out if the system fits to the requirements of the users which are working with. Poor fit between system and users can be caused for example by a complex ERP system implemented, less user involvement during the implementation or the background of the users who were working with a totally different legacy system before. That's why TTF approaches should be used to evaluate the system performance from the user's points of view, the users who are working with the system when forfilling their daily business tasks. The TTF is useful to identify usability gaps and room for improvement of business processes.

Table 1: Comparison of the different success measurement models

4 of the models mentioned above were tested in practical use with different outcomes and different evaluation purposes. Some of the authors tested the models while building the framework. The model of DeLone and McLean (1992; 2003) was tested in different use cases like in 2007 by Chien and Tsaur who found out that system quality, service quality, and information quality seem to be the most important successful factors when they were investigating the success of ERP-systems in Taiwanese high-tech industries. Another finding of their investigation was that the results indicated that technological newness was the most important factor in determining the quality of the system. System quality, such as performance, flexibility of changes, response time, and ease of use, is a technical issue. The result of Chien and Tsaur (2007) confirmed conventional wisdom that the pursuit of state-of-the art technology is a risky proposition.

The Gable et al. model was tested in practical use by Gable et al. (2003) when the authors were validating their findings. But the authors were only interested in model building and not in the results of the 310 valid responses; that's why the results of the survey were not directly published. In 2008 the paper of Sedera studies the proposition that the size of an organization (i.e. small, medium, and large) may have contributed to the differences in receiving benefits from Enterprise Systems. For this research the author used the Gable et al. (2003) model and the study included 66 respondents representing small organizations, 198 respondents from medium and 66 respondents from large organizations, from a total of 27 organizations that had implemented a market leading Enterprise System in the second half of 1990. The author demonstrated that their research provides counter evidence to the popular belief that Enterprise Systems are unsuitable for Small organizations, demonstrating similar benefits and impacts on their larger counterparts.

The model of Ifinedo (2006) was tested by the author himself in the publication of Ifinedo and Nahar (2006) when the authors did a study with companies in the Nordic Baltic region. The authors believe that firms that have no formal methods of evaluating the success of their ERP software could use their revised ERP system success framework for such an exercise as reported in their case studies. Ifinedo and Nahar (2006) found out that system quality and information quality are considered the two important dimensions in the assessment of ERP success for their sampled firms.

The framework of Stefanou (2001) was tested by the author because he wanted to validate his research results. Stefanou (2001) made personal semi-structured interviews and structured interviews conducted through e-mail with nine ERP consultants and project implementation leaders. But there was no test with practical results in the meaning of a selection process done, only the testing of the model previousl described.

5.CRITICAL CONSIDERATION OF EVALUATION IN GENERAL

Drucker (2004) once said: *"What you measure is what you get." "Ensure that every measure of performance is pertinent to the achievement of a goal or value of your organization. Otherwise, you risk misdirecting your organization."*

IT executives know that the right investments in technology can deliver competitive advantage. But in today's business environments the role of the IT is often like electricity, to be managed at minimal cost. By investments in IT innovation, companies have the opportunity to gain a competitive advantage or to change the rules in their industries. The information technologies that support businesses should be adopted and measured with the same decision-making process used for investments in general (Craig and Tinaikar, 2006). Only by measurement of IT success or success metrics the gap between the optimum and the current state can be identified and a strategy for the future development can be made. This shows the importance of success measurement approaches in the IT field for strategic thinking and planning. If the measurement result says that the ERPs performance is poor, that the users are not satisfied with the implemented solution and the transaction time is too high, this outcome is worthless without any action to change this.

Evaluation is often based on standardized questionnaires which were made by evaluator without considering the stakeholder's opinion. Guba, Lincoln (1989) who created the "Fourth generation Evaluation" criticized that common, quantitative evaluation methods are not able to support companies with their complex and dynamic business in a sufficient way. According to Guba and Lincoln (1989) the quantitative evaluation is not appropriate to measure complex interdependences between internal and external influences. Another weak point is that there are a lot of measures which can be of importance which are not considered in a common measurement model and, therefore, a clear statement about the strength and weaknesses of the system can't be made. The "Fourth generation Evaluation" is based on an intensive collaboration and the consideration of the concerns of the stakeholders. That means that an open-minded approach is used and no preconceptions should influence the concept.

The models analysed in this research often include predefined measures as shown in Table 1: **Comparison of the different success measurement models** which can be used for evaluation of the implemented IS or ERP-system. To measure other key figures, which were not considered in the selected model could be an additional challenge. The intensive collaboration between the stakeholders and the team which is doing the success measurement is necessary because the measurements are not limited to those which are currently included. Selecting appropriate measurements can influence the outcome of the evaluation. If a person who is not directly involved and impartial is doing the success measurement, the risk to get sophisticated results is not as high. But if a person, who wants to direct the result of the evaluation to a particular result, is doing the evaluation the risk of a falsification is higher. The selected success measurement model can influence the outcome too because every model has a specific focus.

The stakeholders' participation, which is claimed by Guba and Lincoln (1989,) depends on the model selected. Therefore, the next section of the paper investigates how different stakeholders are considered in each model and which model could be appropriate when doing a practical evaluation for specific stakeholder groups.

6. SUCCESS MEASUREMENT MODELS AND STAKEHOLDER INVOLVEMENT

From the stakeholders' perspective, each stakeholder has a different view on the project outcome. For the achievement of a complete perspective on ERP-success, these views have to be considered when doing the success measurement.

This section shows which models are useful for specific measurement approaches. An investigation regarding dimensions which are interesting for companies or researchers when selecting a success measurement model was made. Each stakeholder has a specific expectation of the outcome of the success measurement. Therefore, the view of the stakeholder must be considered in the used model or else the opinion is not considered in the success measurement result. Due to the fact that the evaluation result is used for different purposes, the selection of the model should be done considering the interests of the group for which the evaluation is made. If e.g. the IT department evaluates the system, the outcome and afterwards the actions taken do not improve the system in a way the users want to . User expectations and IT purposes are often widely different. The top management has other interests as users for example. The top management is interested in cost reduction or in an IT strategy plan; users often want to improve the usability and simplify their daily work. In table 2 the models are investigated in respect of different stakeholders and categorized into 3 groups. X means that the evaluation is integrating or affecting the stakeholder or the evaluation fulfils the dimension defined in the matrix.

Table 2 shows that most models consider the user's point of view. That's clear because the users are working with the system when doing their daily business and are influenced by the (poor) performance directly. For the investigation, the success metrics of the different models were analysed.

The different stakeholders defined are the users, the top management, the IT and the externals. The dimension "Process improvement" which is shown in the matrix means that success measurement leads to a clear identification of the processes which are not optimized and possibly need to be changed. Some models focus on the processes, like the TTF model which tries to show the gaps between the daily tasks and the fit of the processes the according to the tasks.

"Future needs" means that the model investigates if the future needs of the company can be fulfilled by the investigated system or if any changes should be made or if new implementations which may be needed. "Future needs" signifies the strategic planning of the ERP and is a middle to long term dimension. The BSC approaches especially concentrate on the future needs because of the usage of the BSC as a strategic planning instrument in the business environments nowadays.

The dimension "Financials" shows if the model considers financial aspects – like for example external cost or support costs and provides a cost planning / evaluation. This could lead to potential cost reductions and a clear cost structure and is interesting for the (IT-) management.

The "net benefits" in the DeLone and McLean model measure, for example, the cost

savings or the additional markets, that's why financials are rated with an X. An evaluation of with this model can lead to a process improvement, but processes are not influenced directly. "IT" is rated with an X because 3 dimensions are affecting the IT department.

Table 2 additionally shows that the interests of the vendor / externals are not considered in most of the models. Only (Ifinedo, 2006) added an external perspective to his model. But this is only used to evaluate the performance of the externals and not to consider their opinion. It seems that this view is not important for success measurement in practice. An external view would be of interest if the externals would evaluate different customer implementations, the result could be used to compare systems or else the consideration of an external view makes no real sense.

The model of DeLone and McLean (1992; 2003) is primary supporting the users and the IT because it tries to evaluate the net benefits the users are getting from the system. The system and the service quality are directly influenced by the performance of the IT department. The model can lead to a process improvement because of the service quality dimension, which can reveal processual faults. The financials are considered by the defined measures of DeLone and McLean, like cost savings or additional sales.

The Gable et al. (2003) model has two similar dimensions to the DeLone and McLean (1992; 2003) model (system quality and information quality) and 2 different dimensions. The organisational impact has measures which are measuring possible business process changes and financial changes. The other dimension which is different to the DeLone and McLean (1992; 2003) model is individual impact. Individual impact consists of measures which are measuring the progress of the user when the user is working with the system; that's why users play an important role in the Gable et al. (2003) framework.

Ifinedo (2006) added the external perspective to the Gable et al. (2003) model that's the reason why the externals play a role in that model. The other line-ups of table 2 are the same as in the Gable et al. (2003) model.

The model of Markus and Tanis (2000) is considerable for the whole enterprise. The authors defined key actors for every phase of their enterprise system experience cycle and in every phase there are different stakeholders involved. Beyond all phases, all the stakeholders,shown in table 2, are involved and that's why all the stakeholders are rated with an X. Because of the widespread activities, shown in the different phases of the model, they can lead to a process improvement, they consider the future needs of the company (because of the step by step phases) and they also can be used to control the budget (financial metrics).

Stefanou (2001) is considering the all the stakeholders mentioned below. For the ex-ante evaluation of an ERP-system, it's important to involve all the stakeholders in the evaluation and when coming to a final decision. The organisational constraints of the ex-ante evaluation are considering the business processes of the company, and, because of that, the model can lead to an improvement or a change of business processes (based on the selected system). The future needs of the company are considered, otherwise an ex-ante evaluation wouldn't make sense. The aim of the ex-ante evaluation is the selection of an appropriate ERP-system which covers the future needs of the company.

The financials are considered in the financial and time constraints and in the ERP product, vendor and support services evaluation which has to be made in the second part of the second phase of the model.

Rosemann and Wiese (1999) presented a model which considers the users and provides measures which are interesting for the management. The BSC provided by the authors leads to a process improvement (process view), it considers the financials (financial perspective) and the future needs (innovation and learning perspective). Because of this, the related fields in the table below are rated with an X.

Smyth et al. (2001) were concentrating on the tasks and the fit of the task to the technology which is the basis for the fulfilment of those tasks. In the model the users play the most important role because the users are working with the system and they have to manage their daily work with the processes provided by the system. The outcome of the investigation (task-technology-fit) is affecting the business processes and can lead to a process improvement or a business process reengineering. The IT department is only indirectly involved if a change in the system (customizing or modification) is necessary.

Dimension / Model	**User**	**IT**	**Senior Management**	**External**	**Process improvement**	**Future needs**	**Financials**
DeLone & McLean (DeLone and McLean, 1992), (DeLone and McLean, 2003)	**X**	**X**	-	-	**X**	-	**X**
Gable et al. model (Gable et al., 2003)	**X**	**X**	-	-	**X**	-	**X**
The extended ERP Systems Success Measurement Model (Ifinedo, 2006)	**X**	**X**	-	**X**	**X**	-	**X**
Markus & Tanis (Markus and Tanis, 2000)	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Ex-ante evaluation (Stefanou, 2001)	**X**	**X**	**X**	**X**	-	**X**	**X**
ERP BSC (Rosemann and Wiese, 1999)	**X**	-	**X**	-	**X**	**X**	**X**
Task-Technology Fit (TTF) (Smyth, 2001)	**X**	-	-	-	**X**	-	-

X	Stakeholder plays a role in the model	**X**	Use of the model can lead to an improvement
-	Stakeholder is nearly not considered in the model	-	Use of the model does not lead to an improvement

Table 2: Stakeholders and important dimensions for selection of a model

7.CONCLUSION

The objective of this research is a review of different models which could be used for ERP success measurement We found through literature review that ERP systems

success measurement models might be limited in scope and do not suit for every practical case. In particular, this research attempts to build a long needed theoretical base for success measurement studies.

The DeLone & McLean IS Success Model seems to remain the most popular, comprehensive framework for IS success measurement. But there are other models which show interesting alternative approaches to success measurement. Some of the models have a specific approach (e.g. especially designed for the measurement of success for ERP systems) which can simplify success measurement for companies because of the defined, validated metrics. A recommendation which model should be used or which one is the best is not possible.

This paper offers the reader a critical overview with the specific properties and an alignment of the models discussed and allows them to get to know which success measurement approaches exist in the literature and which one would be applicable for the research or practical success measurement case. Some of the success measurement models identified were not discussed in this research due to the fact that the models

- were very similar to other models
- did not contain a suitable approach for ERP success measurement
- had a specific approach in the field of success measurement (e.g. to measure only the management perspective of success in IS)

This study has implications for practice as well. As noted, this study is partly motivated by the need to present practitioners a basis for the selection of a success measurement model. These practitioners need guidelines for assessing the success of their ERP software. The two tables in this research show which models could be of interest for practitioners and researchers. Therefore, the authors defined different dimensions which are differentiating the models from each other and should be used as a basis for the selection of a model. As stated in a section above, success measurement models and stakeholder involvement, the findings are limited to the criteria investigated in this paper. That means that there are different possible criteria which can be used to differentiate one model from another model and the criteria defined in this research are only a possible subset.

Evaluation of success is a difficult approach and it only makes sense if the result of an evaluation is used as a basis for actions which can result in an improvement of the systems performance. Possible outcomes of improvements can be measured through a new evaluation of the systems performance and a comparison of the results of each evaluation. For future research it would be interesting to investigate which actions can be set if an evaluation result of a system is poor in a dimension (information quality, for instance) and which improvements should be made.

Another difficulty in evaluation approaches is that the results are often manipulated by the department which is making the evaluation. The IT department, which is usually the department doing the success measurement, for example, would be interested in a positive evaluation of the system quality. Therefore, the measures, which are part of the

evaluation, can be defined in a way which leads to a positive result. If a model prepares those most important measures, it should lead to a convincing result.

REFERENCES

Behrens S., Jamieson, K., Jones, D. & Cranston, M. (2005). Predicting System Success using the Technology Acceptance Model: A Case Study. 16th Australasian Conference on Information Systems, Sydney

Cameron, K. S., & Whetten, D. A. (1983). Some conclusions about organizational effectiveness. In K.S. Cameron & D.A Whetten (ed.) *Organizational Effectiveness: A Comparison of Multiple Models*, New York: Academic Press.

Chien, S-W. & Tsaur, S. M. (2007). Investigating the success of ERP systems: Case studies in three Taiwanese high-tech industries', *Computers in Industry*, **58**(8-9): 783 – 793.

Cooke, D., Gelman, L., & Peterson, W. J. (2001). ERP Trends. *The Conference Board*, pp. 1-28.

Craig, D., & Tinaikar, R. (2006). Divide and conquer: Rethinking IT strategy, (Online), McKinsey & Company, http://www.mckinsey.de/downloads/publikation/mck_on_bt/2006/MoIT9_ITStrategy_VF.pdf

Curlee, T. R., & Tonn, B. T. (1987). The Success or Failure of Management Information Systems: A Theoretical Approach', *OAK RIDGE NATIONAL LABORATORY for the U.S. Department of Energy under Contract no. DE-AC05-840R21400*, pp. 1 – 23.

Darshana, S., Gable, G., & Rosemann M. (2001). A Balanced Scorecard Approach to Enterprise Systems Performance Measurement. *Conference Proceedings*, Twelfth Australasian Conference on Information Systems, Coffs Harbour.

Davenport, T. H. (1998, July-August). Putting the enterprise into the enterprise system. *Harvard Business Review*, **76**(4): 121 – 131.

DeLone, W. H., & McLean E. R. (2003). The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. *Journal of Management Information Systems*, **19**(4):9-30.

DeLone, W. H. and McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable', Information Systems Research, **3**(1):60-95.

DeLone, W. H., & McLean, E. R. (2002). Information Systems Success Revisited. *Conference Proceedings*, 35th Hawaii International Conference on System Sciences, Los Alamitos.

Ding, Y., & Straub, D. (2007). Using Marketing Exchange Theory to conceptualize IS Quality and Re-conceptualize the IS Success Model. Twenty Eighth International Conference on Information Systems, Montréal

Drucker, P. F. (2004). *The Daily Drucker*. New York: Harpercollins.

Elpez, I., & Fink, D. (2006). Information Systems Success in the Public Sector: Stakeholders' Perspectives and Emerging Alignment Model. *Issues in Informing Science and Information Technology*,**3**: 219-231.

Esteves-Sousa, J., & Pastor-Collado, J. (2000). 'Towards the unification of critical success factors for ERP-implementations. 10th Annual Business Information Technology Conference (BIT), Manchester

Gable, G., Sedera, D., & Chan, T. (2003). Enterprise Systems Success: A Measurement Model', Twenty Fourth International Conference on Information Systems, Seattle.

Goodhue, D. L., & Thompson, R. L. (1995). Task-Technology Fit and Individual Performance. *MIS Quarterly*, **19**(2): 213 – 235

Guba, E. G., & Lincoln, Y. S. (1989). Fourth Generation Evaluation. SAGE.

Hedman, J., & Borell A. (2005). Broadening Information Systems Evaluation Through Narratives', *The Electronic Journal of Information Systems Evaluation*, **8**(2): 115-122.

Holland, C. P., & Light, B (1999). A critical success factors model for ERP implementation', *IEEE Computer Society*, **16**(3): 30 – 35.

Ifinedo, P. (2005). Do Organisational Technological Contingency Factors Influence the Perception of ERP Systems Success? An Exploratory Study in the Baltic-Nordic Region of Europe. *Conference Proceedings*, The 4th International Business Information Management Association (IBIMA) Conference, Lisbon, pp. 427 – 437.

Ifinedo, P. (2006). Extending the Gable et al. Enterprise Systems Success measurement model: a preliminary study. *Journal of Information Technology Management*, **17**(1): 14 -33.

Ifinedo, P., & Nahar, N. (2006). Quality, Impact and Success of ERP-Systems: A Study Involving Some Firms in the Nordic-Baltic Region. *Journal of Information Technology Impact*, **6**(1): 1-28.

Kaplan, R. S., & Norton, D. P. (1997). Using the Balanced Scorecard as a Strategic Management System. *Harvard Business Review OnPoint*, 1-13.

Kronbichler, S. A., Ostermann H., & Staudinger R. (2009). A Review of Critical Success Factors for ERP-Projects. *The Open Information Systems Journal*, **3**:14-25.

Markus, M. L., & Tanis, C. (2000). The Enterprise System Experience—From Adoption to Success. In Zmud, R.W (ed.). *Framing the Domains of IT Management: Projecting the Future Through the Past*, Pinnaflex Educational Resources, Inc., Cincinnatti, (Chapter 10, pp.173-207).

Martinsons, M., Davison, R. , & Tse, D. (1999). The balanced scorecard: a foundation for the strategic management of information systems. *Journal of Decision Support Systems*, **25**: 71 – 88.

May, M. (2003). *Business Process Management – Integration in a web-enabled environment*. Pearson Education: Great Britain.

Montazemi, A., Cameron, D., & Gupta, K. (1996). An empirical study of factors affecting software package selection', *Journal of Management Information Systems*, **13**:

89–105.

Myers, B. L.., Kappelman, L. A., & Prybutok, V. R. (1996). A Care for Including Work Group Productivity Measures in a Comprehensive IS Assessment Model. *Conference Proceeding.* The 27th Annual Meeting of the Decision Science Institute, Orlando.

Myers, B. L.., Kappelman, L. A., & Prybutok V. R. (1997). *A Comprehensive Model for Assessing the Quality and Productivity of the Information Systems Function: Toward a Theory for Information Systems Assessment*. Idea Group Publishing, Hershey.

Nah, F. F.-H., & Delgado S. (2006). Critical Success factors for Enterprise Resource Planning Implementation and Upgrade. *Journal of Computer Information Systems*, 99 – 113.

Nah, F. F.-H., & Lau, J. L.-S. (2001). Critical factors for successful implementation of enterprise systems. *Business Process Management Journal*, **7**(3): 285 – 296.

Nah, F. F.-H., Zuckweiler, K. M., & Lau, J. L.-S. (2003). ERP Implementation: Chief Information Officers Perceptions of Critical Success Factors. *International Journal of Human-Computer Interaction*, **16**(1):5 - 22.

Nicolau, A. I. (2004). Firm Performance Effects in Relation to the Implementation and Use of Enterprise Resource Planning Systems. *Journal of Information Systems*, **18**(2): 79-105.

Praxiom Research Group Limited (1997) 'ISO 9000 2005 – Management Dictionary', (Online), http://www.praxiom.com/iso-definition.htm#Quality, Exeter: Author.

Redenius, J. O. (2005) 'Im Mittelpunkt steht die Wertschöpfung', (Online), IT Management, **3**(1-5), http://www.inditango.com/downloads/IT_Management-032005.pdf

Rosemann, M., & Wiese, J. (1999). Measuring the Performance of ERP Software – a Balanced Scorecard Approach. *Conference Proceeding*, The 10th Australasian Conference on Information Systems, **8**(4).

Seddon, P. (1997). A Respecification and Extension of the DeLone and McLean Model of IS Success. *Information Systems Research*, **8**(3): 240 – 253.

Sedera, D., Gable, G., & Chan, T. (2003). ERP success: Does organisation Size Matter?. 7th Pacific Asia Conference on Information Systems,Adelaide:1075 -1088.

Sedera, D. (2008). *Does Size Matter? Enterprise System Performance in Small*, Medium and Large Organizations', Research presentation at the 3gERP Workshop (Online), http://www.diku.dk/hjemmesider/ansatte/henglein/3gERP-workshop-2008/papers/sedera.pdf

She W., & Thuraisingham B. (2007). Security for Enterprise Resource Planning Systems. *Information Systems Security*, **16**:152–163.

Smyth, R. W. (2001). CHALLENGES TO SUCCESSFUL ERP USE. The 9th European Conference on Information Systems, Bled.

Stefanou, C. J. (2001). A framework for the ex-ante evaluation of ERP software. *European Journal of Information Systems*, **10**:204–215.

Sumner, M. (1999). Critical success factors in enterprise wide information systems projects. *Conference Proceedings*; The American Conference on Information Systems, New Orleans, pp. 232 – 234.

Willcocks, L. P., & Sykes R. (2000). The Role of the CIO and IT Function in ERP.*Communications of the ACM*, **43**(4):32 – 38.

Wu, J. H., & Wang Y. M. (2006). Measuring KMS success: A respecification of the DeLone and McLean's model', *Information and Management*, **43**:728 – 739.

Wu, J. H., & Wang, Y. M. (2007). Measuring ERP success: The key-users' viewpoint of the ERP to produce a viable IS in the organization. *Computers in Human Behavior*, **23**:1582–1596