

# ***ERP System Success Assessment in SMEs***

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**Abstract.** The purpose of this paper is to present a research in progress exploring the issue of Enterprise Resource Planning (ERP) systems success assessment in Small and Medium-sized Enterprises (SMEs). The intention is to provide a sound theoretical basis for a future empirical research. Hence, I go through the extant models of Information Systems (IS) and ERP success in order to identify the most relevant model for application within the SME context. In addition, I present preliminary results based on a pilot case study.

*Key words:* ERP, success assessment, SMEs.

## **1. Introduction**

The issue of IS success has received a significant attention in the research. A number of approaches how to understand “success” of IS in organizational context have been developed. Nevertheless, it is heavily dependent on conceptualization of the success. Many models competing in explaining of IS success has been proposed over the years. These perceive the success in various ways and thus provide different findings and conclusions. The IS success is often interchangeable with terms such as IS effectiveness, or IS performance. In this vein, DeLone et al. (1992) called for “*the quest for the dependent variable*”.

The different models also employ different IS success assessment techniques. However, the IS field needs a consistent IS success measurement necessary for comparison of the results from different studies. In the same time, the IS success measurement is illusive, since the IT impact is influenced by indirect factors such as human, organizational, and environment factors (Petter et al. 2008).

In general, the IS success has been investigated in two main research streams: *user acceptance* and *user satisfaction* (Wixom et al. 2005). These two approaches provide two different stand-points on the

IS success issue. While the user acceptance stream is represented by Technology Acceptance Model (TAM), DeLone and McLean (D&M) IS success model is the main representative of the user satisfaction approach. Over the time several different models have evolved within each stream. There has even been an attempt of integrating these two approaches (Wixom et al. 2005).

The TAM has been introduced by Davis (1989). It posits a *user acceptance* as the main modeled variable. However, acceptance is not equivalent to success (Petter et al. 2008). One of the main criticisms of TAM is its limitation in terms of using only the *user acceptance* dimension as a measure of success. Especially, in a case of a mandatory system the user acceptance is not appropriate measure of IS success. In terms of ERP systems the mandatory use is common. Once an ERP system is implemented in an organization the employees are often required to use the system, regardless they accept the systems or not. Because of that the *user acceptance* does not provide relevant information about the success of the system. Therefore, in this paper I follow the *user satisfaction* stream.

In comparison to other areas of ERP related research, e.g. implementation, the aspect of ERP success assessment has comparatively less attention in the literature. Because of the lack of knowledge, firms adopting ERP systems usually do not know how to properly assess or evaluate the ERP success (Ifinedo 2006). This particularly applies to SMEs.

Most of the studies dealing with ERP success measurement have been focusing on a limited number of success dimensions. Only few studies have captured the multiple nature of ERP success. Moreover, none of them has focused on specific organizational settings. ERP success is likely to be different in different organizational conditions. This research is solely focusing on SMEs in order to reveal new findings specific for ERP success in SMEs.

## 2. Extant Success Measurement Models

This section presents an overview of selected existing IS/ERP success models. The models are briefly introduced and their applicability is discussed.

### 2.1. IS Success

DeLone et al. (1992) is one of the first studies addressing an integrated view of IS success concept. Based on a literature review the authors have developed IS success model (see Figure 1). The model incorporates six dimensions (categories) of IS success: *systems quality*, *information quality*, *use*, *user satisfaction*, *individual impact*, and *organizational impact*. The associations between the variables are demonstrated by arrows. As can be observed from Figure 1 these variables are interdependent. The D&M model has become very popular and its IS success taxonomy has been widely used in the IS literature.

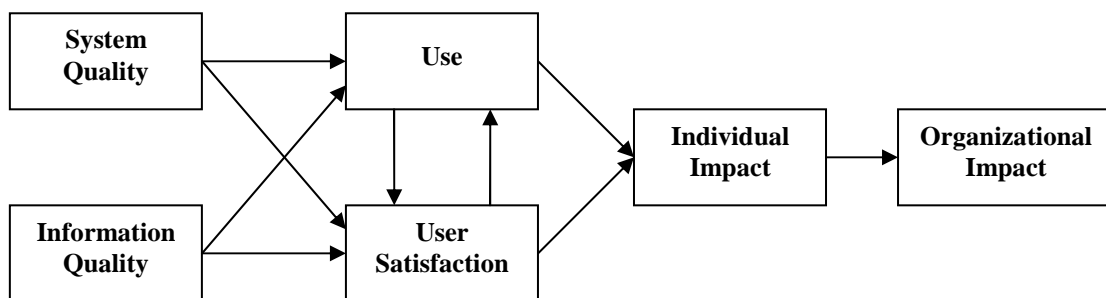


Figure 1: D&M model (DeLone et al. 1992)

A quality is represented by two dimensions: *system quality*, and *information quality*. These two variables affect *use* and *user satisfaction* of IS. The model posits that *user satisfaction* leads to increased *use* of IS. Similarly, positive experience with *use* leads to greater *user satisfaction*. Thereby, *use* and *user satisfaction* are closely interrelated. As a result of both these variables *individual impact* will occur. And in the final *individual impact* has an effect on *organizational impact* (DeLone et al. 1992). The effects can be either positive or negative.

Moreover, the D&M model suggests various measures of IS success. In total, it involves 112 possible measurement items distributed across the six dimensions: *systems quality* (18), *information quality* (23), *use* (22), *user satisfaction* (9), *individual impact* (21), and *organizational impact* (19). The choice of the measurement items depends on the organizational context of the particular study. Thus, it is left up to the researcher to choose the most appropriate measures.

Over the years several researchers have tested the relationships posed by D&M model (e.g., Iivari 2005; Sabherwal et al. 2006), and proposed the model modifications and extensions (e.g., Ballantine et al. 1996; Seddon 1997). The model has also been revised by its authors ten years after the release (DeLone et al. 2002; DeLone et al. 2003). This update has been based on a literature review of studies on IS success evolved during the period. The authors have addressed the proposed modifications and have incorporated adequate changes.

The D&M model has been applied and in various contexts, e.g., e-commerce (DeLone et al. 2004). In general, application of the D&M model depends on the organizational context. Characteristics of the studied IS and organization determine the measures of each success dimension (Petter et al. 2008). Thereby, the success measures will vary according to the type of IS.

There exist a number of IS used in organizations, e.g. knowledge management systems, decision support systems, customer relation management systems, supply chain management systems, enterprise resource planning (ERP) systems, and many others. These systems differ in a number characteristics and parameters. Thus, the measurement of their success requires different approaches as well.

Seddon et al. (1999) have developed a matrix for classifying IS effectiveness measures. The matrix provides a guideline for selection of success measures based on a type of system and stakeholder under the study. Based on level of analysis they have defined six types of systems and five different stakeholders (interest groups). Thereby, 30 possible classes of IS success measures are introduced. However, the classes are somewhat broad and difficult to follow. For instance, it is not very clear which category ERP systems should fall in.

## **2.2. ERP Success Measurement**

The models developed for measuring of IS success in a traditional IS context are not entirely appropriate for measuring ERP success (Gable et al. 2003). It is caused by the specific ERP characteristics. There exist a number of success factors unique for ERP systems (Tan et al. 2002). The ERP success assessment is challenging because of its complex nature (Ifinedo 2006; Markus et al. 2000).

The ERP system implementation is crucial for any enterprise since it affects the whole organization. Many studies define the ERP success as a fixed issue. However, it is often considered differently by different organizations. Moreover, the success is usually perceived differently by different individuals within an organization, representing various users of the system. Thus, the success perception differs depending on a number of conditions.

Many studies have used limited measures in ERP context, for example often used only *user satisfaction* dimension as a measure of ERP success (Nelson et al. 2001; Zviran et al. 2005). User satisfaction is certainly one of the important IS success dimensions, but should not be used as the only indicator. In order to measure ERP success rigorously a comprehensive approach is necessary.

One of the first attempts to develop a specific success measurement model for ERP context has been carried out by Gable et al. (2003). The authors have developed a multidimensional instrument for enterprise systems<sup>1</sup> success (ESS) measurement. The ESS model builds upon the D&M success model (DeLone et al. 1992). Furthermore, the measurement assessment is based on Myers et al. (1997) framework.

The model has been built based on a literature review and an exploratory (inventory) survey. The identified success dimensions and measures have been revised in order to meet the ERP characteristics as follows:

- a) The *use* construct has been omitted from the model. Because ERP systems are usually mandatory to use in an organization, the extent of use provides little information about the success of the system (Gable et al. 2003).
- b) A more holistic *organizational impact* measure has been developed. The D&M model measure does not account all potential organizational impacts of ES system (Gable et al. 2003). Therefore ES-related measures of organizational impact have been incorporated such as *cost reduction, increased capacity, business process change, staff requirements, and e-government readiness*<sup>2</sup>.
- c) In addition, *customization* has been identified and included as an important measure of system quality.
- d) Several measures have been omitted from the model. These measures have been most often overlapping with other similar ones and thus they have been considered as unsuitable for the model (Gable et al. 2003).
- e) Based on a factor analysis of the survey data the *satisfaction* dimension was excluded.
- f) Moreover, 6 *systems quality* items and 4 *information quality* items were eliminated

Thereby, the final validated ESS model has evolved. In total it involves 27 measures of four dimensions: *information quality, system quality, individual impact, and organizational impact* (see Figure 2). The model does not propose any causality effects between the dimensions. It is purely measurement model for assessing the ERP success (Gable et al. 2003). The items are scored on a 7-point Likert scale.

Petter et al. (2008) found that the ESS model is the most comprehensive tool for IS measurement. Since the model measures four key success dimensions and involves at least four items for each of them, it has strong construct validity. The instrument captures the multinational and complex nature of ERP success (Petter et al. 2008). One of the other strength of the ESS model is that it avoids overlapping between the constructs and measures.

The ESS model has been further validated by Sedera et al. (2004). By applying factor and structural equation analyses the study tested reliability and construct validity of the model. Thus, the results confirmed a strong model relevance.

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<sup>1</sup> The terms enterprise system and ERP have been used interchangeably.

<sup>2</sup> The *e-government* item has been included because the survey was conducted in a public sector. An *e-business* or *e-commerce* items are direct counterparts in case of private sector (Gable et al. 2003).

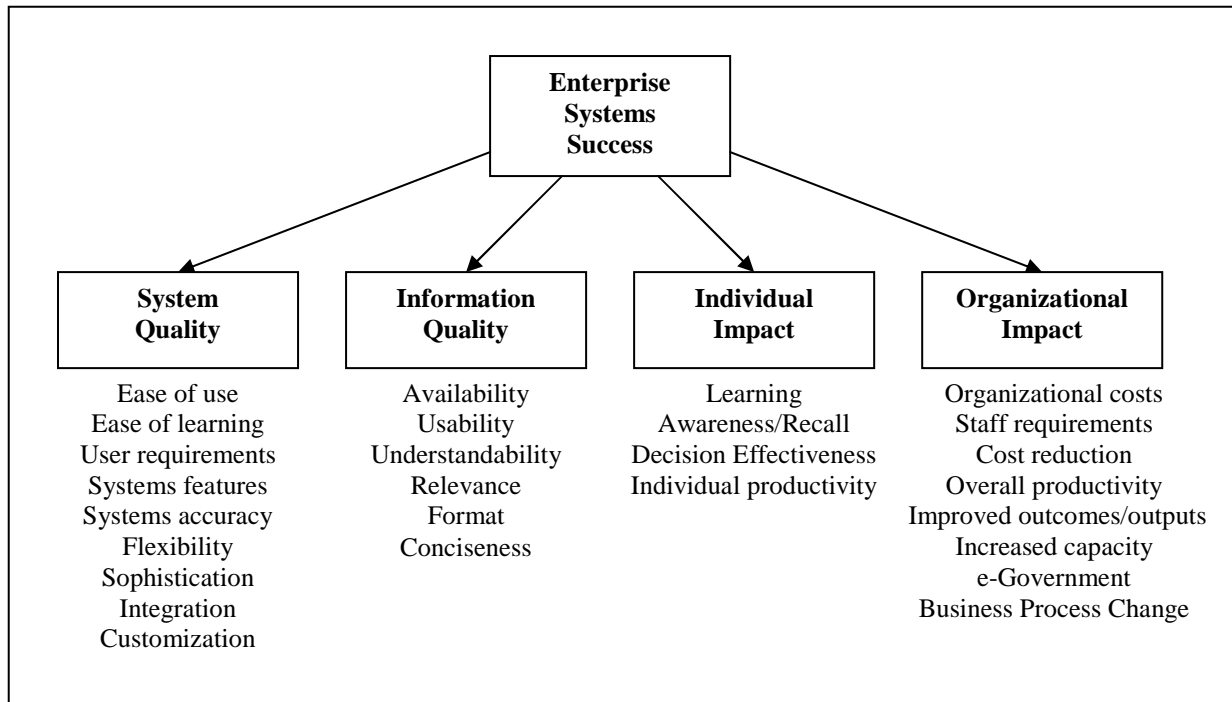


Figure 2: ESS model (adapted from Sedera et al. (2004))

The ESS model has been employed in several studies (e.g., Sedera et al. 2003b; Sehgal et al. 2004). Moreover, it has been further redefined by Ifinedo (2006). The author has investigated whether the model is really comprehensive and if it could be extended by any other relevant dimensions. Importantly, in contrast to Gable et al. (2003) and Sedera et al. (2004) work, this study's focus has been on private sector. The author argues that "*generalizing research findings across both sectors could be misleading*" (Ifinedo 2006, p.16). The data has been gathered through a survey of 62 subjects within 44 private companies from two European countries (Finland and Estonia).

Based on a literature review and the author's previous research (Ifinedo et al. 2006) the author has suggested incorporation of two more dimensions into the ESS model: *vendor/consultant quality* and *workgroup impact*. Hence, the Ifinedo's model of ERP systems success measurement involves six dimensions (see Figure 3)<sup>3</sup>.

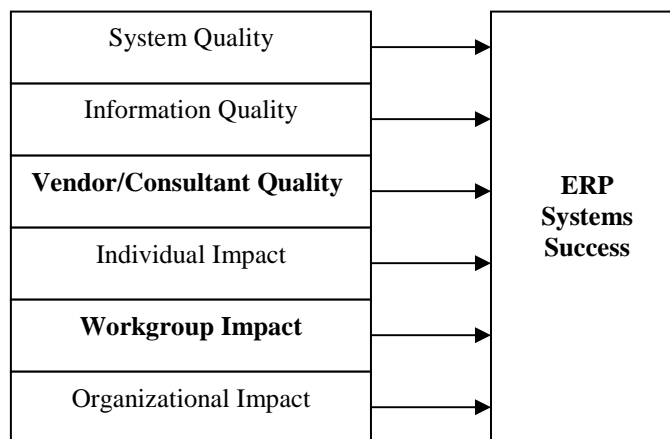


Figure 3: Ifinedo's model (Ifinedo 2006)

<sup>3</sup> The added dimensions are in bold.

Each success dimension is measured by a number of items. The items in general correspond with the ESS model instrument, however some items have been added. The number of items in particular dimensions is as follows: *system quality* (11), *information quality* (8), *vendor/consultant quality* (5), *individual impact* (6), *workgroup impact* (7), and *organizational impact* (8). The instrument is using a 7-point Likert-type scale to assess the measurement items.

The developed model has been employed in a number of the author's later studies (e.g. Ifinedo 2007; Ifinedo et al. 2007; Ifinedo et al. 2009). The results confirm relevance and validity of the model. Up to my knowledge, the Ifinedo's model represents the most comprehensive ERP success measurement instrument. It offers an exhaustive measurement technique of ERP system success.

As has been advised: "*more MIS researchers should seek out success measures that have been developed, validated, and applied in previous empirical research*" (DeLone et al. 1992, p.81). In the light of that, I will adopt the Ifinedo's model as a framework for further investigation of its applicability within SME environment.

### **3. ERP Success Assessment in SMEs**

One of the limitations of the study by Ifinedo (2006) is that the explored sample consisted of diverse enterprises in terms of their size (including small, medium, and large). The author himself mentioned that a research aiming on a homogenous group of organizations might yield different results (Ifinedo 2006). The purposed of the research presented in this paper is to explore applicability of the Ifinedo's model within SME context.

Studies of ERP implementations argue that findings from large companies cannot be applied to SMEs since they represent a fundamentally different environment (Buonanno et al. 2005; Mabert et al. 2003). SMEs are not smaller versions of large enterprises (Welsh et al. 1981). A number of important aspects likely to affect ERP implementation differentiate SMEs from large companies, such as lack of resources (in terms of finance as well as human), insufficient IT competence, and lack of experience with IS implementation projects in general.

A little research attention has been given to SMEs regarding ERP success measurement. An exceptional study has been conducted by Sedera et al. (2003a) who investigated influence of organizational size on ERP success. Using the ESS model the findings confirmed the proposition that organizational size contributes to the differences in receiving benefits of ERP systems. However, the study is somewhat limited in its scope. It employed only data from public sector organizations which implemented one type of ERP system (SAP). Moreover, the study only investigated the differences in ERP success performance. It was not intended for investigating a relevance of the measurement instrument itself.

The intention of this paper is to investigate applicability of the selected assessment model and explore how particular success dimensions match the SME environment. In this vein, some dimension can be found inappropriate, and on the other hand some new dimensions specific for ERP success in SMEs can be discovered. Thus, a modified model corresponding organizational characteristics will evolve.

#### **3.1. Research Methodology**

The study will be conducted by using a mixed methods approach, combining qualitative and quantitative research (Bryman 2008). Mixed methods research has received significant attention in the IS field (Gable 1994). The literature mentions a number of arguments in favor of mixing research methods. The combination of different research methods provides richer and more reliable research results (Mingers 2001). One of the emphasized advantages is data triangulation. The triangulation serves a higher data validation by combining a range of data sources, methods, or investigators

(Bryman 2008; Eisenhardt 1989; Gable 1994; Mingers 2001). Moreover, the mixed methods research is considered to produce higher generalizability of the findings compared to using each method separately.

According to Creswell's (2009) typology of mixed methods strategies, this research will apply the Sequential Exploratory Strategy. First, a qualitative data collection and analysis will be conducted, and it will be followed by a second phase of quantitative data collection and analysis. The second phase builds on the results of the first qualitative research. Thus, the finding from qualitative data analysis complement the quantitative data collection (Creswell 2009). This strategy addresses the intention of this research to explore the subject first, and to validate the findings through a quantitative study afterwards.

Concerning research methods, this research integrates case study and survey. A case study seeks to explore and understand the investigated subject. However, the findings can be contextual and may not be generalizable to a wider sample. The intention of case study research is to investigate the problem in a natural setting in detail, bring different insights, understand the process in general, and learn about the state of art (Gable 1994). On the other hand, a survey method seeks to provide generalizable statements about the studied sample, usually through discovering common relationships and determining associations between the variables. However, the survey is limited in providing supplementary information about the gathered data, since it is only a snap-shot at a certain time. Rather than discovery, a survey serves as a verification tool (Gable 1994). Therefore, it is desirable to perceive these methods as complementary rather than competing approaches. Their combination provides a richer and deeper understanding of the studied problem.

The research design of this study follows a framework introduced by Gable (1994), who has elaborated on integrating case studies and surveys within IS. The research design is proposed in two phases (see Figure 4).

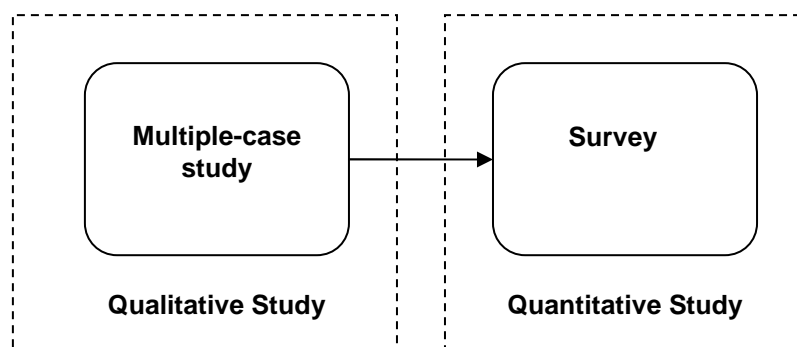


Figure 4: Research design

First, a multiple-case study (Yin 2008) study will be carried out. This exploratory study will show relevance of particular success dimensions, and potentially indicate other important issues for further investigation. The findings are expected to support model modification. The measurement instrument will be verified and finalized through a cross-case analysis.

The planned number of the companies is 4 SMEs. As data collection technique a combination of personal interviews and document analysis is proposed. The intention is to conduct several personal interviews with various respondents in the company. The respondents should come from different positions, including top management, end users, IT responsible persons, etc. This will yield different perspectives in order to enrich the findings. The interviews will be semi-structured and face-to-face, following Myers & Newman's (2007) guidelines for conducting qualitative interviews. The data collection will also involve analysis of documents provided by the company. As a supplementary data

source, information provided by vendors or consultants who have been involved in the ERP implementation is considered as well.

Regarding the criteria for selecting the companies a variety between them will be required. The intention will be to include companies representing various conditions in terms of organizational characteristics (e.g. different businesses, various organizational structures, ownership type, etc.) as well as different aspects representing ERP system implementation (e.g. implementation methodology, number of implemented modules, ERP system customization, etc.). These characteristics are expected to affect the ERP implementation success. The cross-case analysis will provide a comparison and inclusion of the findings.

Once the measurement instrument is settled and the dimensions identified, these will be further utilized in a survey. A questionnaire developed based on the previous qualitative study will be utilized. The survey will serve a quantitative analysis in order to explore significance of particular success dimensions. Structural Equation Modelling (SEM) is proposed as an approach for data analysis. Considering the nature of the proposed research the SEM is an appropriate method for data analysis.

## **4. Pilot Case Study**

In this section I present preliminary findings from the first conducted case study. I call it a pilot study in this paper. The exploratory research methodology allowed collecting rich descriptive data on an ERP implementation project in a SME in its natural setting.

### **4.1. Case Company**

The case company is a manufacturing SME engaged in fiberoptic equipment production. It has approximately 220 employees. The company manufactures a variety of products in six product divisions. The company is dynamically developing organization and cooperating with international partners and customers. It is located at one location, without any subsidiaries and branches.

In the middle of 2007 the company decided to invest in a new ERP. The main reason was an unsatisfactory legacy system. The outdated system became significantly limiting. Moreover, the company was using other separate systems including an accounting system, attendance system, and software for production control. Since all these applications worked separately, data export and import between them were complicated, and were often solved by manual data transcription. As the company has expanded through the years this has become very time consuming and inefficient.

In the very beginning of 2008 an ERP system selection was initiated. A small local IT company operating as a certified agent of the biggest domestic ERP vendor was selected. An accounting module was implemented in the beginning of January 2009 and the full system was launched by mid-April 2009.

### **4.2. Data Collection**

The data were collected through 14 qualitative interviews. All interviews were face-to-face involving one interviewee, except an introductory interview where project leader and his assistant were both present. I gathered data from employees representing various positions within the company. I interviewed 13 different respondents, among them the project leader, project leader assistant, middle and top management (including CEO), key users, end user, and IT staff. The respondent variety yielded different perspectives to enrich the findings through data triangulation (Bryman 2008).

13 of the interviews were recorded. On average the interviews lasted for approximately one hour, varying between 20 up to 90 minutes. The data collection took place within one week (5 working

days) and all interviews were carried out inside the company (in meeting rooms). All recorded interviews were carefully listened to and analyzed. The important parts and supporting quotes were transcribed.

The questions covered various issues of the ERP implementation project, diverging in a level of abstraction (from general to very concrete). The interviewees were asked about their personal experiences and opinions about the implementation project and the ERP system itself, about its outcomes and limitations, specific issues regarding the company characteristics, etc.

In addition, I collected information from the vendor. I conducted a telephone interview with the vendor’s CEO. The telephone interview lasted for approximately 20 minutes focusing on questions regarding specificity of the implementation project in the case company. Another supplementary telephone interviews were also conducted with the project leader and sales manager. Furthermore, emails and documents provided by the company were utilized as additional data sources.

### 4.3. Preliminary Findings

The case company did not define explicit success definitions or measures. The ERP system implementation project was interpreted as successful by all the interviewees, although perceptions of a success differed. The success was most often cited as the fact that the production was not stopped. The company core business was certainly the main concern regarding the success perception.

Another often expressed perception of the success was the user acceptance of the system. Employees have taken the system into use without any serious trouble. They also learned to work with the system in quite a short time. In general the system has been accepted well. Some minor negative opinions occurred, but they were purely individual problems.

Many system benefits were specified during the interviews. In total, 30 benefits were recognized. These include higher data lucidity, better data analysis possibilities, increased data security, etc. Table 1 illustrates the most common cited benefits.

Table 1. ERP system benefits

<i>Benefits</i>
Analysis possibilities (data filtration, search possibilities)
Reduced working time
Lucidity - better data overview
Work simplification
Data security
System approach - process optimization
More accurate outcomes – reduced data error rate
Paper saving - environment friendly
Platform for future development
Easier data export and import

An interesting issue arose about working time and work simplification. While some interviewees argued that the system reduced their working time and simplified the work, some said the opposite. Since the system offers more possibilities in terms of data analysis, it requires more work to provide sufficient data. In some cases it can be slower.

However, no evaluation of the system benefits or outcomes has been carried out in the case company. No parameters for ERP outcome assessment were specified a priori. There existed some general expectations from the system (e.g. increased responsiveness to the customers, faster delivery),

but they were not evaluated retrospectively after the implementation. Actually, these parameters were identified as inappropriate because of higher system requirements as discussed above.

Another identified problem is the lack of use monitoring in the old system. This limits any comparison. Moreover, it was stated that it is not possible to use general parameters (e.g. overall turnover, number of reclamations) because the external changes have more significant influence than the system implementation. In addition, since the company is dynamically developing, it was seen as difficult to isolate the effects of the system. These criteria were found to be difficult to quantify.

## **5. Conclusion**

The pilot case study showed that the company was unable to perform ERP system outcome/ ERP success measurement evaluation. The company faces a dynamically evolving environment. Therefore the assessment of general business parameters (such as cost reduction, overall productivity, increased capacity, business process change) in relation to ERP system implementation was deemed to have limited validity. The company found that the effect of other, usually external forces, on the measured parameters was more significant than the implementation of an ERP system.

The case study showed that the company did not have resources for a proper ERP outcome evaluation. Moreover, the ability to evaluate the ERP outcome was also limited by the lack of comparable historical data. Developed tools such as by Ifinedo (2006) could be helpful for SMEs to assess the outcomes of ERP implementation. However, its applicability within SME context needs to be verified.

This paper presents a research in progress involving only preliminary findings from the pilot study. Thus, the aim of the paper is rather to invoke a constructive discussion about relevance of the proposed research.

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