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Factors affecting evaluation of e-business projects

Evaluation of
e-business
projects

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Abstract

Purpose – Despite rapid expansion of e-business, the research on corresponding evaluation is relatively rare. This paper studies the factors that impact how companies evaluate their e-business projects.

Design/methodology/approach – Paper starts with conceptualization of factors that affect the usage of e-business evaluation. The empirical part is based on representative telephone survey ($n = 755$) among Slovenian companies in 2003. The causal model (LISREL) was applied on this data.

Findings – Only about one tenth of the companies with sizeable e-business projects employs some type of formal e-business evaluation. One reason for that might be high satisfaction with e-business. Among formal methods return on investments and cost benefit analysis dominate. However, once a company decides to apply evaluation approach it will use more methods, usually three or four. The attitudes towards e-business are the most important factors affecting the implementation of e-business evaluation methods. Surprisingly little differences were noticed in respect to the size of the company, its IT infrastructure, as well as the number and variety of e-business projects.

Practical implications – The attitudes of the IT management are crucial for employing evaluation of e-business projects.

Originality/value – The paper revealed that the perceptions of e-business most strongly affect the corresponding e-business evaluation practice. On the other hand, the high occurrence of problems related to e-business implementation has a negative impact on the introduction of evaluation methods.

Keywords Electronic commerce, Project evaluation, Slovenia

Paper type Research paper

Introduction

In its broadest sense, the term e-business is usually understood as the application of information technologies (IT) into a business process. Despite various terminological problems, the notion of e-business extends the more narrow understanding expressed with the term “e-commerce”. The latter typically relates to the process of buying, selling, or exchanging products, services, and information via computer networks as it typically excludes some not-strictly-commercial applications, such as communication, administration, conducting electronic transactions within an organization, etc. (Greenstein and Feinman, 2000; Laudon and Laudon, 2002; Turban *et al.*, 2004).

Throughout the literature, e-business has often been studied from the technical (information and communication technology) (Pastuszak, 2003), organizational, managerial (Pastuszak, 2004) or legislative aspects, while there are fewer studies that deal with the economic aspects and with the corresponding evaluation. Nevertheless, the latter presents an important supplement to the former aspects, as it can provide an answer to most important questions related to the justification of



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the e-business investments and implementation (Hasan and Tibbits, 2000; Ngai and Gunasekaran, 2004).

With some exceptions, it is relatively hard to find scholarly research (Chong, 2002; Cummings, 2004; Varian, 2002; Kleist, 2003; OECD, 2004) on this topic. There are many reasons for such shortcomings. One, for instance, lies in the fact that the existing methods of investment justification (e.g. the method of net present value, the cost-benefit analysis, return-on-investment analysis, etc.) are not even suitable for IT-related projects let alone for e-business projects (Martinsons *et al.*, 1999). E-business IT investments are physically distributed between suppliers and vendors, making the investment payoffs analysis potentially more difficult for evaluators to clarify (Klein and O'Keefe, 2001). The next problem relates to rapidly changing nature of the phenomena in this area. Owing to the changing role of e-business, it is thus difficult to adopt specific financial models (Greengard, 2000). The problem is particularly demanding, because the proper assessment of e-business projects should include – besides standard economic theory approach – also the features of traditional IT projects, as well as the features related to the specific nature of e-business. IT investments are freighted with measurement complexity (Lucas, 1999; Baccarini *et al.*, 2004) and e-business investments are even more complex to evaluate than traditional IT investments due to the inter-organizational nature of e-business.

Within this challenging context, we have investigated in this paper how companies are dealing with the need for the evaluation of their e-business. However, due to the broadness of the problem, we have narrowed the scope of our research to the issues related to whether and why companies introduce such evaluation. We thus did not explain the question of specific models developed for the evaluation itself in detail, but did predominantly focus on different types of evaluation approaches and the factors that affect their applications.

First, we have started with the overview of the research literature. Next, we have developed the conceptual framework of the factors that may affect the practice of the evaluation. The central part of the paper deals with the application of this conceptual model in an empirical study. A special survey on e-business evaluation practices among Slovenian companies was conducted for this purpose in 2003. We have presented the general findings of this study and then proceeded with the development of the corresponding causal model for the factors affecting the usage of evaluation methods and procedures. Finally, at the end of the paper, we have outlined the conclusions along with the suggestions for the future research.

Review of previous research

The evaluation of benefits arising from the implementation of IT is traditionally a very difficult task. This holds true for micro as well as for macro level (Kauffman and Walden, 2001; Vehovar *et al.*, 2001; Atrostic and Nguyen, 2002; Zhuang and Lederer, 2003; Ahmad *et al.*, 2004).

The measurements of the corresponding contribution at a national level are particularly complicated (OECD, 2004; Atrostic and Nguyen, 2002), although very important. The studies that would properly evaluate the contribution of IT to the economic growth and to the increase in national level of productivity are central for the understanding of strategic role IT has in modern economy. One major achievement in this area was the recognition that it was the role of IT in its broadest sense that

contributed to the sharp increase in productivity level in the US in 1990s, which also stimulated the fast growth of the entire US economy (Jorgenson, 2001). Of course, serious methodological problems accompany this type of research (Clayton *et al.*, 2003).

The international empirical studies on e-business implementation are also relatively rare and they rarely touch the specific issues of evaluation. One exception is the E-Business Watch project, which monitors the e-business activities in the European Union (EU). Recently, with the so-called Sector Impact Studies (www.ebusiness-watch.org/ (accessed 15 July 2003)) they also focused on the effects of e-business on productivity, which is an important component of e-business evaluation. Some indirect findings are also reported in the SIBIS survey, conducted in 2002 among European enterprises (SIBIS, 2003).

Similar approaches can also be found in some national statistical offices, especially those joining their efforts in OECD (www.oecd.org) activities on e-commerce. Specific activities to measure the IT contributions on national level also exist within EU methodological groups, especially in UK (Clayton *et al.*, 2003). On the other hand, the Eurostat (<http://europa.eu.int/comm/eurostat/> (accessed 1 September 2004)) also launched the annual standardized survey on IT and e-commerce among companies in all 25 member states.

We face similar problems with e-business evaluation also at the company level. The problems of intangible and difficult-to-measure contributions of the IT investments traditionally accompany these issues, which can be observed from the very beginning of more intensive implementation of IT into the business processes in the 1960s. One aspect of this problem has formalized in the so-called productivity paradox (Lucas, 1999), which elaborates in great detail the problems related to the measurement of the IT investments.

The lack of proper quantitative methods to justify the IT contribution was partially compensated with the increase in alternative measures. Typically these are expressed as the benefits of competitive advantages, innovativeness, indirect gains, and in particular, with some perceptual and attitude measurements (Beheshti, 2004). Within this context, the satisfaction measures have become especially popular. Although such attitudinal measurements typically use quantitative statistical tools and ordinal scales, many authors include them among qualitative approaches (Kleist, 2003), together with Delphi studies, SWOT analysis, balanced scorecard (Hasan and Tibbits, 2000), etc. On the other hand, the notion of "quantitative" approaches would relate only to hard statistical measures, most typically to those arising from financial data. As the "qualitative" approaches usually show much higher approval of IT-related investments than the quantitative ones, it is strongly recommended to establish a certain balance between the two approaches. The corresponding final evaluation of e-business thus must not be too qualitative, so to encourage improper undertakings, but also not too quantitative to discourage good projects (Kleist, 2003, p. 256).

As mentioned, the case studies directly dealing with these issues at the organizational level are relatively rare. Several research studies have evaluated the impact of e-business usage and dealt with the justification of e-business projects from the economic viewpoint (Barua *et al.*, 2001; NOIE, 2001; Cummings, 2001; RIS, 1999, 2002; Varian, 2002).

The influence of e-business on profits and costs has been studied by the Brookings Institution along with the Momentum Research Group (Varian, 2002). Their research

has been carried out on a representative sample of companies from the Dun & Bradstreet database, including 2,065 in the USA and 634 companies from France, Germany and Great Britain. Only about 20 per cent of the respondents saw no payoff from their e-business investments. Financial impact of e-business introduction can be seen as an increase in revenues or a decrease in expenses. Surprisingly, more than 63 per cent of investigated enterprises have no formal procedures for the assessment of the impact of IT investments, despite the fact that the management believes that a metrics for the assessment of such impact is necessary.

According to the research carried out by IDC in summer 2000 in more than 650 companies, which accomplished the projects of introducing e-business, only 33 per cent of companies used any of the existing return on investment (ROI) analysis, 16 per cent of surveyed companies did not know if the analysis had been carried out, and 51 per cent of companies did not use any of the traditional ROI analysis. In the companies that carried out ROI analysis, the results met expectations in more than 50 per cent (Cummings, 2001).

The specific assessment of e-business was also systematically conducted in Slovenia (RIS, 1999, 2002; Vehovar and Jovan, 2003) in the continuous national research on e-commerce RIS 1996-2002, where, in 1998, a third (32 per cent) of enterprises could not have properly estimated the amount of their profit made on the internet. This percentage further increased during the last years. The recent survey on e-business was conducted in December 2002/January 2003 among 1,282 Slovenian companies. One result, relevant to our research, is the following, namely, that the majority of firms believe that e-business should lower costs by more than 10 per cent to justify its implementation (RIS, 2002).

The above-mentioned research shows many attempts on how to evaluate investments in e-business, despite various associated difficulties that go along with it. The question on whether and why companies introduce a formal evaluation of e-business projects, has not been properly explained in the research.

Research questions and research model

Based upon the experience of the available previous research and the general literature on e-business (Kauffman and Walden, 2001; Plant, 2000; Green, 2002; Yap, 2002), we have investigated the factors affecting the practice of implementing the evaluation approaches for justifying e-business projects. Specifically, we have been interested in providing answers to the following research questions:

RQ1. What is the general attitude and satisfaction with e-business projects?

RQ2. How do companies evaluate their e-business activities?

RQ3. Which are the methods used for evaluating e-business projects?

RQ4. Which of the company's characteristics has the strongest affect on methods for evaluating e-business projects?

RQ5. Do the presence of different types of e-business (e.g. B2B, B2C, etc.), the size of e-business projects, or the ICT intensity as well as the type of the company; have any influence on evaluation methods?

RQ6. What is the role of the perception and the attitude on e-business on the approaches to the evaluations of e-business projects?

In the paper, we have basically studied the role of the company's characteristics – including its IT component, the number, size and type of applied e-business projects – on the evaluation of e-business projects. As an important intervenient variable the attitudes towards e-business were also incorporated into our study.

Conceptually, we can structure the relationships in the following model (Figure 1) taking into account the authors who deal with the e-business metrics (Jagannathan *et al.*, 2001; Stern, 2002; Straub *et al.*, 2002a, b; Zhu and Kraemer, 2002) and other relevant literature which deals with approaches and indicators of successful e-business companies (Kleist, 2003; Ahmad *et al.*, 2004; Leem and Kim, 2004; Eid and Trueman, 2004) together with our own experience and findings (Lesjak *et al.*, 2003).

The basic hypotheses are thus as follows:

- (1) The IT developments of the company affect:
 - the attitudes towards e-business, particularly the perception and understanding of its role in the company,
 - the usage of evaluation methods.
- (2) We also still expect a strong and independent role of the attitudes themselves on the implementation of more intensive formal evaluation approaches.

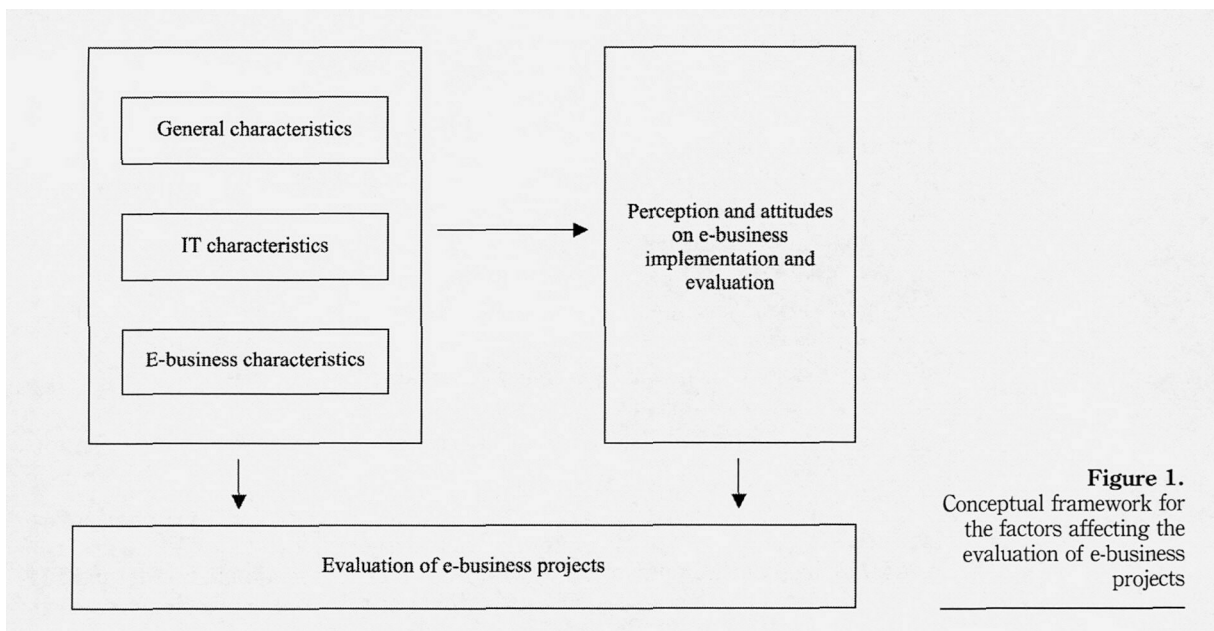


Figure 1. Conceptual framework for the factors affecting the evaluation of e-business projects

The data

We studied the above conceptual model with the data gathered among Slovenian companies. Slovenia is a small European country finishing economy transition (Strašek and Jagrič, 2002) with 2 million inhabitants situated among Italy, Austria, Hungary, and Croatia. It has joined the EU in 2004. In general, the Slovenian developments in the area of IT are roughly around the EU average (Vehovar and Jovan, 2003; Lesjak and Cohen, 2001). In the global economy of contemporary businesses, where IT plays a more and more standardized role, the findings of our study could be thus useful – if not inferable – also to the businesses in other developed economies.

The empirical survey research we present here was entirely devoted only to the issues of the evaluation of e-business projects. The initial sampling frame was based on responding companies from December 2002 national representative RIS e-business survey ($n = 1,260$, response rate 70 per cent). The RIS research (www.ris.org) is performed annually since 1996 and presents a leading source for studying the trends in e-business and information society in Slovenia. The RIS (2002) sample was a representative stratified sample of all Slovenian companies, however, the self-employees and home businesses were excluded (i.e. SOHO business).

In addition to the respondents from 2002 survey, the non-respondents from this survey were also included into the sampling frame for the 2003 survey, as well as the companies that reported specific internet usage, but were not explicitly claiming to have e-commerce.

The survey was performed over the telephone in June 2003. Altogether 1,112 companies were contacted. If needed, at least up to ten contacts were made with the selected companies. The IT responsible persons were the target responding units, while for the smallest companies the directors or owners were addressed.

In total, 755 companies responded. As usual, the response rate was much higher among large companies. Out of 755, some 335 companies report sizeable e-business project that exceeds 4,000 Euros. With these companies, we were interested in the formal evaluation methods for their e-business undertakings.

Exploratory analysis

In the questionnaire, first, the presence of e-business activities was checked. The companies had to explicitly report the usage of four types of e-business activities:

- applications for their core business activity, including the application of the internal flow of the documents (B2E);
- applications for the exchange of the business documents with partners and other organizations from business sector (B2B);
- applications with final customers, including online sale with credit card authorization (B2C); and
- applications installed to exchange documents with the public administration (B2A).

In Table I, we can observe that among all companies in the sample with at least one e-business project, the B2E type prevails. It is closely followed by B2B, both being present in almost two-thirds of these companies. On the other hand, the B2C and B2A application can be found less often, each within one-third of these companies.

Of course, companies typically have more than one type of the above-mentioned e-business activities. Among all 755 companies, in 646 (85.6 per cent) units they have at least one type of e-business activity. Here, the remaining 14.4 per cent of companies with no e-business arose, not from the sample of companies that reported e-business in December 2002, but from additionally included segments in 2003 survey as described above (i.e. non-respondents in 2002, etc.).

The next filtering question was related to the presence of (at least one) e-business project that exceeded 4,000 Euros with sub-contractors or having (at least one) e-business project exceeding one person per month of work of their employees. Only 335 companies out of 646, which initially reported some e-business activities, have at least one explicit project of this minimal size. These 335 units with sizeable e-business projects were also the companies that were included into the additional 10 minute block of questions on e-business evaluation. The remaining companies were at this point excluded from further questions. We assumed that they had no actual experience with their own e-business projects, as these are the companies that would typically adopt only some standardized e-business solutions from their business partners, from their banks or from the government.

The majority of the 335 companies have less than five sizeable e-business projects. The companies with more projects tend to have projects of smaller size, while companies with large project typically have fewer projects.

If the corresponding person-months of the employees engaged in the e-business projects were recalculated into the Euros[1] (as a general approximation we assume one person-month equals 4,000 Euros), that they could be combined with the reported subcontracting costs related to the same project. Here, the measurement problems were substantial and the item non-response rate was relatively high (around 40 per cent). Despite that, it gives us a general impression for the maximum size of the projects. The major mode for the project's size is 15-30,000 Euros, while another – much smaller mode – relates to the projects larger than 60,000 Euros. We should also add that the largest project in this survey amounted to around 400,000 Euros. These relatively small figures should be paralleled with the structure of the companies according to their size. There we can observe that 90 per cent of the companies in the sample have less than 250 employees and even the largest company has less than 4,000 of employees. Obviously, we basically deal with the e-business projects of small and medium size enterprises (SME). It is plausible that different relationships may be discovered for large businesses and for multinational companies.

It is important to note that all the proceeding analysis will be thus referring only to these 335 companies with sizeable e-business project. Occasionally, however, in some tables the totals may be smaller due to filtering questions or due to specific item non-response.

Presence of e-business type (multiple response)	Share of companies (per cent)
B2E	64
B2B	60
B2C	34
B2E	34

Table I.
Companies according to
the presence of e-business
types (companies with
some e-business
activities, RIS 2003
survey, $n = 646$)

Table II presents the key dependant variable of our study – the usage of the formal methods for evaluating e-business projects.

We can observe that roughly one-fifth ($n = 65$) of the companies with sizeable e-business project already use or plan to use some formal evaluation of their e-business projects. On the other hand, two-thirds (66.6 per cent) of these companies do not use any methods and they have also not even thought about evaluating their e-business projects. This is comparable with the results of the research carried out by the Brookings Institution in the 2001, where more than 63 per cent of investigated enterprises have no formal procedures for the assessment of the impact of IT investments (Varian, 2002), and also with the research carried out by the IDC in summer 2000 where only 33 per cent of companies used certain ROI analysis (Cummings, 2001). Somehow lower percentage in our survey can be partially attributed to the prevailing segment of SME companies in our sample.

Altogether out of 65 companies that were using or preparing to use some evaluation methods only 45 actually already applied these methods. Among them, the ROI and cost benefit analysis (CBA) are the most frequent formal methods (Table III), while NPV is used in one-third of these companies. Here, we additionally asked for the usage of informal methods, which obviously prevail among the companies, which already use some formal approaches. We found that they are applied in about two-thirds of all the companies with some evaluation of e-business. In addition to this, companies report relatively often about other methods, such as ISO standards, 20 Keys, Scorecards, etc. Sometimes they also claim that they developed their own procedures of evaluation.

We can also observe that the companies typically employ more methods, most likely four of them (48 per cent), while only 13 per cent would use one method. The most commonly used option is the usage of the combination of informal methods, ROI, CBA and other methods (36 per cent).

Table II.
Methods for evaluating e-business projects (companies with sizeable e-business activities, RIS 2003 survey, $n = 335$)

Usage of formal evaluation methods	<i>n</i>	per cent
Use some methods	45	13.4
In preparation to use	11	3.3
Plan to use within next 12 months	16	4.8
Thinking about usage	40	11.9
Have not thought about usage yet	223	66.6
Total	335	100.0

Table III.
Types of the evaluation methods applied among companies (companies using some formal evaluation methods, RIS 2003 survey, $n = 45$)

Evaluation method	Method in usage per cent	Method in preparation per cent	Thinking about per cent	Not in use per cent	Total per cent
Informal methods	82	4	3	11	100
ROI	66	2	2	30	100
CBA	64	7	7	22	100
NPV	39	5	2	55	100
Other methods	31	2	9	60	100

Let us now observe the attitudes towards e-business. Companies were first estimating their general attitudes and perception towards their e-business projects (Table IV). The respondents rated their agreement with the statements on a five-category ordinal scale from 1 (totally disagree) to 5 (totally agree).

There are some differences according to the size of the company, namely with larger companies the agreement is higher for the statement on the financial evaluation requests from the management and for the statement on the needs for more information. On the other hand, smaller companies are generally more satisfied with their e-business projects.

With respect to other variables (type of e-business, number of projects, size of the largest project) the differences are relatively small, except for the size of the project, where similar effect can be observed as with the size of the companies.

We analysed the above statements also with the factor analysis. Two factors appeared, each explaining around 40 per cent of the variance:

- factor 1 expresses the general satisfaction with e-business projects (corresponding associated variables are shadowed in Table IV); and
- factor 2 is related to the presence of a high need for the evaluation of e-business projects (corresponding associated variables are not shadowed in Table IV).

Similarly, we measured the perception of the problems companies encounter with the implementation of their e-business projects (Table V). High score denotes that companies encounter certain problem.

We should note here that the lack of time for proper evaluation ranks as the most exposed problem related to e-business implementation. Companies are thus strongly aware that they need some type of evaluation.

The corresponding factor analysis aggregated the above attitudes into two dimensions, each explaining almost half of the variance:

Statements: attitudes towards e-business	Mean
<i>Our company is satisfied with the economic impacts of e-business</i>	3.6
<i>E-business usage increases satisfaction among all participants in the process</i>	3.6
<i>Our company is satisfied with the procedures for the evaluation of e-business projects</i>	3.0
Impacts of e-business are so obvious that there is no need for their evaluation	3.3
There is lack of knowledge and information on evaluation of e-business projects in our company	3.3
Our management demands financial evaluation of e-business-related investments	3.2

Notes: Attitudes towards the problems related to e-business implementation, shadowed area separates the variables that are associated with the two factors (see explanation below) from factor analysis: agreement on 1-5 scale (companies with sizeable e-business projects, RIS 2003 survey, $n = 335$);

Table IV.

Statements: e-business implementation problems	Mean
<i>Lack of time for the evaluation</i>	3.3
<i>Lack of knowledge on evaluation</i>	3.0
<i>Problems with subcontractors</i>	2.9
<i>Problems with educating users</i>	2.9
Prolongation of the project	2.9
Exceeding of the planned costs	3.1
Problems with the measurements of effects of e-business projects	3.1
Notes: Attitudes towards the problems related to e-business implementation, shadowed area separates the variables that are associated with the two factors (see explanation below) from factor analysis: agreement on 1-5 scale (companies with sizeable e-business projects, RIS 2003 survey, $n = 335$);	

Table V.

- factor 1 is related to high problems of the e-business implementation (the corresponding associated variables are shadowed in Table V),
- factor 2 is related to the good planning and formalizing of e-business projects. Negative values thus denote here the weakness in this aspect. We should add that the variables that characterize factor 2 also have high loadings on factor 1 (the corresponding associated variables are not shadowed in Table V).

If we draw the companies in the two-dimensional space of the above two factors, we would observe a clear pattern: companies with more implementation problems related to their e-business project (factor 1) are also the companies with lower values on the factor that measures the planning aspects of their e-business projects. On the other hand, in the two-dimensional space of factors from Table IV we find no clear pattern; the units are entirely scattered.

With respect to the IT characteristics of the companies we expect them to be much above the corresponding average of all 755 responding companies in RIS 2003 sample. In addition, of course, these 755 companies are also expected to have much better IT infrastructure than the general population of all Slovenian companies.

As an illustration of IT infrastructure we mention here the PC usage. Roughly, a good third (38.4 per cent) of companies have less than one-third of employees using PC at work regularly, while within one-third of the companies (33.3 per cent) all employees regularly use PCs. As expected, the average share of regular PC users decreases with the size of the company, from 77 per cent among smallest (micro) to 14 per cent among large companies.

We should add here that the internet access exists in all companies, while the median share of employees with the access to the internet – which is another important indicator of the IT infrastructure – is close to 50 per cent. Here again, smaller companies enable the internet access to a much higher percentage of employees than the large ones.

The causal model

Very often in social and economic research, the variables are inter-correlated in a relatively complicated manner. The multivariate approach, which treats all variables simultaneously, is thus necessary to reveal the underlying structure of the data.

As we have studied here the causal relations among the variables outlined in the conceptual framework (Figure 1), we employed the structural equation model approach.

We have measured the concepts from Figure 1 with the following variables:

- (1) Characteristics of the company. The observed variables, which arise from 13 items related to the basic characteristics of the companies, are structured into three segments: general characteristics of the company, ICT infrastructure characteristics and e-business characteristics. As described in Appendix, some of these items were further linearly combined, so we measure the three aspects with following five variables:
 - SIZE: Size of the company according to the official classification;
 - N_EMPLOY: Number of persons employed in an organization (we used logarithmic transformation of the variable);
 - IT: IT uptake was calculated as an average of PC/employee ratio and percentage of internet users among employees (we used logarithmic transformation of the variable);
 - NPROJECT: Number of sizeable e-business projects;
 - EB_VAR: Number of different types of e-business projects (B2E, B2C, B2A, B2B).
- (2) Perception and attitudes on e-business implementation and evaluation. These intervenient variables were based on four factors from attitudinal measurements:
 - (1) two dimensions of the general attitudes on e-business projects:
 - EV_SATIS: satisfaction with e-business (factor 1 in Table IV),
 - EV_NEED: need of e-business evaluation (factor 2 in Table IV);
 - (2) two dimensions of the attitudes on e-business implementation problems:
 - EB_PROBL: implementation problems (factor 1 in Table V),
 - EB_PLAN: well planned e-projects (factor 2 in Table V).
- (3) Usage of the evaluation. The key dependant variable was the level of implementation of evaluation procedures (Table II), where the category of the companies that actually use some evaluation procedures was additionally structured as described in Appendix.
 - (EVAL_INV): degree of involvement into e-business evaluation.

The detailed description and construction of the variables are in the Appendix.

The model was estimated by normal theory maximum likelihood using the LISREL 8.51 program (Jöreskog *et al.*, 2000). For structural equation models it is assumed that variables are at least approximately normally distributed. This was not entirely satisfied in our case, as some of the variables were strongly skewed. For skewed distributions we applied the usual remedy for this problem, i.e. the logarithmic

transformation. With the remaining discrepancies we refer to several studies indicating high robustness of these models regarding the assumption of normality (Boomsma and Hoogland, 2001).

The causal models have the standard diagnosis expressed with χ^2 statistics and corresponding p -value. The p -value is typically requested to be above 0.05 and preferably closer to 0.5, so that the model cannot be rejected.

Another important measure to evaluate these models is the root mean squared error of approximation (RMSEA) value. According to Saurina and Coenders (2002, pp. 222-3) the standardized χ^2 test of the hypothesis of perfect fit to the population covariance matrix (i.e. the p -value) should be given less importance than the measures of the degree of approximation between the model and the population covariance matrix. The RMSEA is typically used for this. Values equal to 0.05 or lower are generally considered to be acceptable (Browne and Cudeck, 1993).

The standardized regression coefficients, which are usually labelled over the arrows in the path diagram, are also extremely important for the interpretation. For example, the value 0.25 of this coefficient means that the change in one standard deviation of the independent variable causes an increase that can be expressed as 0.25 of the standard value in the dependant variable. Typically, the corresponding t -values larger than 1.96 denote a strong causal relation among variables.

The path diagram for our model is shown in Figure 2. We assume that the causal order basically flows from the observed characteristics of the companies to intervenient variables: implementation problems (EB_PROBL), planning of e-business (EB_PLAN), satisfaction with e-business (EB_SATIS), and also to the need of e-business evaluation (EV_NEED). Of course, according to the conceptual

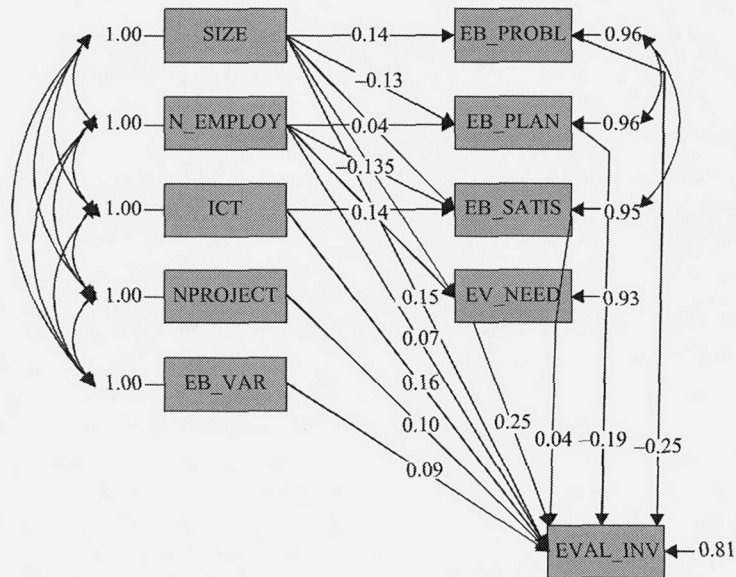


Figure 2.
Path diagram with standardized values of the estimates for the causal effects (RIS 2003 survey, $n = 335$)

Note: Chi-square = 22.34, $df = 16$, P -value = 0.13266, RMSEA = 0.042

model (Figure 1), all above-mentioned variables should also affect the degree of evaluation involvement (EVAL_INV).

The path diagram in Figure 2 shows the standardized regression coefficients and also the standardized effects of the unexplained variances (the short arrows pointing to the variables). As these latter values are relatively high, this denotes substantial level of the variability that remained unexplained. However, the proportion of the unexplained variance for the target variable (EVAL_INV) has the value of 0.81, which is acceptable. Even more, such a value is much above usual expectations for this type of problems, where the attitudes are involved. Of course, the proportions of the unexplained variance for the intervenient variables are much higher. We have value 0.93 for the problems with e-business (EB_PROBL), which was particularly strongly influenced by the size of the company (SIZE) with the standardized regression coefficient of 0.14 ($t = 2.07$). The other three-intervenient variables also have similarly high values for the share of unexplained variance (0.95). These high proportions of the unexplained variances for the intervenient variables somehow confirm observation from the previous section: the attitudes show relatively little variation across the control variables.

The model has good explanation power according to the standard diagnostics. The RMSEA of the model is 0.042, which indicates acceptable fit of the model. The p -value (0.13) is also considerably high and suggests that the model cannot be rejected.

The model also reports on the strength of relation among observed variables themselves and also among the intervenient ones. The corresponding arrow links can be found in Figure 2, however, the related correlation coefficients are omitted from the diagram for the sake of simplicity and predominantly also because values were not so high. The only exception is the high negative value of the correlation (-0.70), between the two factors (EB_PROBL and EB_PLAN) of "problems with the implementation of e-business" (Table V). We should add that this was also an observation at the end of previous section, where we mentioned the specific pattern of the scatter-plot, when drawing the companies into the space of these two factors.

With respect to the impact of the observed and intervenient variables on the key target dependant variable (EVAL_INV) we can summarize the following:

- As expected, a strongly articulated need for the evaluation (EV_NEED) also increases the actual evaluation of e-business project; we can observe here the strongest causal link in the whole model, with the value 0.25 ($t = 3.96$).
- Problems with the implementation of e-business (EB_PROBL) and with the corresponding planning (EB_PLAN) reduce the e-business evaluation involvement, as their standardized coefficients take high negative values, -0.25 ($t = -2.71$) and -0.19 ($t = -2.13$), respectively. Here we should add that the high perception of the problems related to e-business implementation (EB_PROBL) also moderately decreases the satisfaction with e-business (EB_SATIS). The corresponding arrow link can be found in Figure 2, while the correlation value (-0.12) is not explicitly labelled in Figure 2.
- Higher satisfaction (EB_SATIS) with e-business shows only a slight tendency to stimulate the evaluation involvement (EVAL_INV). The corresponding value 0.04 of the standardized regression coefficient is positive, although it is not statistically significant ($t = 0.61$).

- The impact of the basic observed variables on the dependant variable is generally not significant. Nevertheless, the signs and the direction of the causal links are logical and expected. The role of IT infrastructure seems to be the strongest among them, with the standardized value of 0.16, which is also very close to the usual significance level ($t = 1.88$). The number of employees (N_EMPLOY) has the lowest effect with 0.07 ($t = 0.47$), while the number (NPROJECT) and the variety (EB_VAR) of the projects have moderate values around 0.10 ($t = 1.55$). Similar is true for the impact of the size of the company (SIZE), with the value 0.15 ($t = 1.23$). We can speculate here that with a slightly increased sample size, some of these links would also become statistically significant at standard significance level ($t = 1.96, p = 0.05$).
- Some other links were removed from the model, because the corresponding standardized coefficients were around zero and they were not statistically significant, so they do not contribute to the model.
- The size of the largest project was not included into the model due to the cumulative effects of high item non-response. The problems with this variable are regrettable, because indices from bivariate analysis show that it actually has a relative effect, similar to the variable related to the size of the companies.

Conclusions

This paper has investigated how companies are coping with the evaluation of e-business projects. We have developed a conceptual model for the factors affecting the use of formal evaluation methods and we have verified this model on a representative survey among Slovenian companies.

We can answer the initial research questions as follows:

- (1) The majority of companies with e-business projects report a strong positive economic effect of e-business on their companies and their operations. The overall satisfaction with e-business is also relatively high (3.6 on 1-5 scale).
- (2) A large majority (86 per cent) of the companies with sizeable e-business projects do not use any formal methods of evaluation and they also do not yet think about their implementation. Almost half of them also agree that the effects of e-business are so obvious, that no evaluation is needed. On the other hand, however, the majority of companies also believe that the lack of time for proper economic evaluation is the greatest among the problems they face when implementing e-business. This somehow demonstrates the ambiguous, inconsistent and relatively contradicting perception of e-business evaluation. Perhaps the best explanation for this would be to label the attitudes towards e-business evaluation as not clearly articulated.
- (3) Among the evaluation methods ROI and CBA approaches dominate, followed by NPV. A variety of other methods were also observed. In particular, many companies developed their specific, tailored approaches towards the evaluation of e-business.
- (4) Surprisingly, the basic characteristics of the company have a relatively limited impact on the usage of evaluation for e-business projects. Still, the high IT

intensity seems to have the strongest direct impact among them. The size of the company has larger indirect effects than the direct ones. As a consequence, in the multivariate settings it is less important than in the bivariate analysis.

- (5) The findings from the causal model confirmed that the degree of the evaluation involvement is explained mainly with the perception of the problems related to e-business and with the attitudes towards e-business evaluation, and not so much by the characteristics of the organization and the characteristics of the e-business project.
- (6) The attitudes towards e-business implementation and evaluation thus play the key role on the actual usage of evaluation procedures. It is important to note that experience of the problems with e-business implementation has a negative impact, while the satisfaction with e-business and the recognized need for evaluation have a positive impact on the practice of e-business evaluation.

The highly negative role of the perceived problems with e-business implementation deserves a special interpretation. Why would high experience with the problems lower the tendency to adopt solutions to these problems? In search for this answer we follow the indirect effect via satisfaction, as it may indicate proper signs of the relations. Of course, more problems with e-business decrease corresponding satisfaction, while it seems to be the high satisfaction that increases the evaluation involvement. Consequently, the problems with e-business implementation also decrease the evaluation involvement.

For what we know another definition is needed: where is the positive relation between satisfaction of e-business and the corresponding evaluation practice coming from? This question is particularly important, because almost half of the companies agree that evaluation is redundant due to obvious success and satisfaction with e-business project. We can speculate here that there actually exist another underlying latent variable, which can be labelled as "advanced understanding and implementation of e-business". Companies with high level on this variable provide complete and proper treatment for their e-business projects, from planning and formalization, to the evaluation stage. They also provide successful and satisfactory e-business implementation. The companies, which are high on this scale, thus have both, high satisfaction with e-business and also high involvement in evaluation procedures. Unfortunately, in the design stage of the survey, these relations were not yet that clear, so the measurement instrument was not developed to further elaborate this issue.

In any case, this research has demonstrated an extremely important role that the attitudes and perception of e-business have on the implementation of e-business evaluation procedures.

Another measurement problem in this empirical study relates to the indicators for the size of projects, which was not measured entirely successfully. As a consequence, it could not be included into the causal model. This presents, no doubt, another weakness of the model. Nevertheless, due to the high correlation with the size of the companies, we can still assume that the major loss in the model did not occur.

In future, the research on factors affecting the application of e-business evaluation should:

- elaborate the measurement instrument to capture the IT component in a much wider and detailed aspects;
- improve the measuring of the size of the project, together with a more specific location in time characteristics; and
- expand the model to measure the latent variable, which would denote the general level of the understanding and elaboration of e-business project in the company.

We should also add that results confirm the initial problem with justification of e-business projects, particularly the discrepancy among a relatively high need for using formal evaluation methods and the limited practice of such evaluation. On one hand, when evaluating e-business projects the traditional assessments of investment cannot be used, because permanent change and a variety of qualitative and indirect benefits prevent the applications of the corresponding financial models. On the other hand, however, the existing evaluation methods may be truly inadequate and their results may actually not be worth the efforts.

From a more substantial point of view, the research is also needed to evaluate the effectiveness of e-business evaluation methods. How useful is the application of a certain evaluation approach? Are these approaches generally not used because they are ineffective? Or, they are useful, but they are not used, because of the ignorance of the potential users? Or, do the players in e-business implementation intentionally avoid the formal evaluation?

Nevertheless, our results show that there is a clear need for more elaborated evaluation procedures. Combined with a dominant lack of their usage, we can basically point to the insufficiency of the existing methods. The use of traditional methods should be thus at least combined with qualitative approaches (Kleist, 2003), together with Delphi studies, SWOT analysis, etc. if not substituted with new promising methods such as portfolio method (Chong, 2002), Loyalty Value Added methodology (Greengard, 2000; OECD, 1999), benchmarking method (E-Commerce Benchmarks, 2001) and balanced scorecard (Martinsons *et al.*, 1999; Hasan and Tibbits, 2000).

Note

1. Euro is the currency of the EU and it roughly corresponds to one US dollar.

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Appendix. Variables in the model

SIZE. Size of the company (Differentiation of companies between according to the official categories: micro, small, medium, large, the largest):

- Micro up to 5 employees;
- Small from 5 to 50 employees;
- Medium from 50 to 250 employees;
- Large from 250 to 500 employees;
- The largest more than 500 employees.

N_EMPLOY. Number of persons employed in an organization. We used logarithmic transformation of this variable.

ICT. ICT uptake. (This variable was calculated as the average of percentage of PCs per employee and percentage of internet connections per employee. We used logarithmic transformation of the variable.)

NPROJECT. Number of large projects was calculated as a sum of projects worth more than 4,000 Euro, or, exceeding one-person month of work of the employees. The higher is the value, more large projects company has.

EB_VAR. Variety of employed e-business types

- (1) one type of e-business in use;
- (2) two types of e-business in use;
- (3) three types of e-business in use; and
- (4) four types of e-business in use.

Problems and experiences with e-business project

EB_PROBL. implementation problems (first dimension of problems with introducing e-business)

Companies, which have stronger weight than 0.4 on that dimension, more strongly agree with the statement that e-business brings problems with lack of time for evaluating and justifying projects, with the evaluation know-how, lack of knowledge, with educating users, with subcontractors.

EB_PLAN. Well planned e-projects (second dimension of problems with introducing e-business)

Companies, which have stronger weight than 0.4 on that dimension, more strongly agree with the statement that e-business brings well-planned projects, which do not prolong the processes and do not exceed the planned costs.

Evaluation of e-business projects

EB_SATIS. Satisfaction with e-business (first dimension of e-business evaluation)

Companies, which have stronger weight than 0.4 on that dimension, more strongly agree with the statement that they are satisfied with the financial impact of e-business usage, that implementation of e-business brings satisfaction of participants in those processes, that they are satisfied with e-business evaluation processes.

EV_NEED. Need of e-business evaluation (second dimension of e-business evaluation)

Companies, which have stronger weight than 0.4 on that dimension, more strongly agree with the statement that impact of e-business usage is not trivial and there is a need to evaluate it and the management require economic justification of e-projects.

EVAL_INV. Degree of evaluation involvement

Variable degree of evaluation involvement has the following values:

- (1) companies, that have not been considering the implementation of e-business evaluation yet;
- (2) companies, that have been considering e-business evaluation, but have not performed it yet;
- (3) companies, that are already using one evaluation method (or are preparing to use one in the near future);
- (4) companies, that are already using two evaluation methods (or are preparing to use one in the near future);
- (5) companies, that are already using three evaluation methods (or are preparing to use one in the near future);
- (6) companies, that are already using four evaluation methods (or are preparing to use one in the near future); and
- (7) companies, that are already using five evaluation methods (or are preparing to use one in the near future).