UNIVERSITY OF DEBRECEN
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Director:
Prof. Dr. Szabó Gábor, DSc.

Dissertation abstract

FUNCTIONAL, EFFICIENCY AND ECONOMIC ASSESSMENTS OF COMPUTERISED INFORMATION SYSTEMS AT SMALL AND MEDIUM SIZED ENTERPRISES

Submitted by:

Rózsa Tünde
Ph.D. student

Supervisor:

Dr. habil. Herdon Miklós
Associate Professor, Ph.D.

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1. RESEARCH OBJECTIVES

Integrated information systems under large-scale company conditions have become widespread over the past decades. Information, data management and systematic information produced from these data and arranged according to needs, however, are required by not only large-scale companies but small and medium-sized enterprises as well. This is the need that was also recognised by the staff that developed the ERP[1] system and successfully appeared on the market with a product range developed for SMEs[2].

Integrated systems support the management and execution of enterprise activities with success and efficiency. By introducing an ERP system the internal flow of information, the internal integration and the cooperation between the functioning sub-units will improve. Investments in informatics, however may be costly in addition to becoming obsolete quickly.

The improvement of information and communication technologies continuously influence the development of information systems, the introduction of different solutions in architecture and the application of new business models. Newer and newer versions of the different systems are being developed. My assumption, based on examples from abroad and ERP solutions developed for SMEs, was that these systems should necessarily and inevitably become widespread in Hungary as well. The spread of these systems on a large-scale, in relation to more developed countries, however, is hindered by factors pertaining to economic, human resources and social issues. Apart from investigating the improvement of ERP systems this research focused on systems currently employed in SMEs, their receptiveness and the preparedness of the enterprises themselves. Relying on the results of these investigations the objective was to work out a system of tools and recommendations that may be helpful to SMEs and those dealing in ERP in choosing and introducing these systems more efficiently. In more detail, the objectives of my research were as follows:

1. **The investigation of the evolution of ERP systems** in order to make a survey of currently used systems and the system solutions expected to be operational in the coming years. The assumption is that that the improvement of ERP systems over the past decades concerns the enhancement of their functionality. Different technologies and solutions, such as SOA (Service Oriented Architecture) provide opportunities for further technological and content-related (functional) extensions and assist the development and spread of new business models (SaaS – Software as a Service). **Getting to know** and

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[1] ERP - Enterprice Resource Planning
[2] SME – Small and Medium sized Enterprise

analysing **the ERP supply market** also constituted an important part of this research. It is also an objective to get to know the supply situation in Hungary and to look out on the market abroad. It is suggested that the market for ERP is also characterised by globalisation and as regards the number of its implementation in Hungary the solutions developed by well-known international companies lead the market (SAP, Microsoft, …). The analysis of the supply and demand markets of ERP systems has a considerable effect on the part of this work aiming at constructing a functional system of requirements.

2. With the help of available surveys and also **assisted by my own surveys the incidence, the manner of introduction, the opportunities for assessing returns and the advantages and disadvantages of ERP systems in small and medium sized companies are investigated** side by side with judgements concerning the importance and necessity of certain modules and functions. At first the occurrence of ERPs in SMEs is judged to be low**.** There are no decision supporting tools available for SMEs that might assist them in the processes of making their choices and assessments. There are, nevertheless, methods and methodologies but you need experts if you want to apply them. In addition, it is suggested that most small and medium sized companies would favour the use of similar tools if they were at their disposal.

3. The activities of a business define the integrated system it can choose from the ERP offers to support its processes. This way functionality has an influence on the process of making choices and the economic evaluation of the system implemented as well. Analysis by function is regarded to be indispensable for conducting further investigations and so **the investigation of the functional system of requirements for integrated systems of company management in small and medium sized companies.** In the course of these investigations I would like to deal with analysing the functions of ERP systems on offer for TÉSZs (TÉSZ = production and sale cooperative) and the additional functional requirements concerning food industry solutions. It is supposed that the process of implementing and assessing ERPs in small and medium sized companies operating in the food and agricultural industries differs from similar processes in other small and medium sized companies in the extra functions resulting from the special characteristics of these activities.

4. This hypothesis assumes that small and medium sized companies have neither human nor capital resources to either analyse the market before implementing ERP or conduct a suppliers' assessment. This is the reason why **developing a selection aid was set as an objective of this research**, which tool was to give information on functionally suitable

systems and their suppliers as well as a decision supporting tool based on a multifactoral assessment process, with the help of which potential suppliers and systems can be evaluated.

5. For company managers and owners it is judged to be a vital piece of information when and how a system implemented will bring returns. In order to address this requirement for information an **objective of this research was to create an evaluation model.** In the calculation system developed the expenses and returns of an ERP investment are evaluated by using various financial indicators. The functionality of the calculation system is attempted to be proved by doing case studies.

2. EVENTS PRECEDING, RESEARCH METHODS APPLIED

Large scale businesses in the Hungarian economy have already partly introduced some kind of company management system. As a result of the publication of the outcomes of these attempts more and more small and medium sized enterprises are also recognising that traditional company management offers fewer hopes for establishing competitiveness at a European level. It is favourable for small and medium sized businesses that operators in the supply market have also recognised these needs. At present there are over one hundred companies in Hungary that supply integrated administration and company management systems and about 20 of these companies conducted the overwhelming majority of the turnover in this segment in 2004.

This thesis deals with the technical literature in the individual chapters as parts of the relevant chapters. It was considered purposeful to deal with the technical literature in this way as laying down the theoretical foundation for a certain topic area makes the understanding and evaluation of a given part easier. The different subparts in my research required the application of different approaches, which were as follows:

In the course of conducting **„desk" research and secondary analysis** an overview of publications and other technical literature in the field was carried out, which was followed by selecting and processing the information of the relevant problem area together with comparative analyses of the data and trying to find the best practices.

A questionnaire survey was conducted among users and suppliers of ERP systems, which proved to be a useful source of information in later stages of the research activities. There were restricted opportunities in selecting samples and the addressees of the questionnaires sent out were winning applicants of No. 4.1 of GVOP and members of the SME section of the

Chamber of Commerce in Hajdú-Bihar County. The questionnaire could be filled in an online form via the Internet (http://odin.agr.unideb.hu/rozsa/kerdoiv) and was also sent out in a printed and electronic form.

In the course of conducting **interviews** professionals of informatics businesses and specialists of the Chamber of Commerce were asked in detail about the content and methodological issues related to the questionnaire survey. Comprehensive technical interviews and consultations were vital for preparing the case studies. The interviews conducted in the knowledge of the results of the questionnaire survey and having the experiences from the field work provided an opportunity to more thoroughly deal with the most serious issues and key questions identified earlier.

Comparative methods of analysis were made use of in evaluating system selection methodologies, economy evaluation methods, metrics and comparing the different systems.

Quantitative and qualitative analyses were conducted in several phases of this research but the emphasis here is laid on the use in the case studies, which also served the testing and verifying of the calculation system developed.

3. MAJOR CONCLUSIONS OF THE THESIS

One of the objectives of this research was to prepare a survey that may result in answers to most important issues for the research itself from a larger group of users. Several businesses were contacted while conducting this research yet they can be regarded as individual cases as they do not always reflect the general state of affairs in the area. The results and findings of the research work and the related conclusions are summarised below.

3.1. The application of erp systems in small and medium sized businesses

It proved impossible to survey the whole range of users so an attempt was made, according to clearly defined objectives, to select that part of the users who could possibly give answers to the questions that had emerged. The investigation was mostly based on a survey with the following objectives:

- How the suitable computerized information system is, would be or was identified,
- What the most important factors are in choosing an ERP system,
- To what extent it is characteristic for SMEs to introduce integrated or standalone systems,
- How important the individual modules are, what modules are used and what modules are envisaged in the future,
- What advantages and disadvantages the information system implemented brought for the company,
- What amount the company was, is or would be willing to spend on implementing an ERP system or the maintenance of the system implemented,
- Whether the different subsidies available influence company decisions,
- Where, in what areas, the returns from the system, implemented are considered to be suitable for measuring.

In selecting the samples the opportunities were limited. The addressees of the questionnaires sent out were winning applicants of No. 4.1 of GVOP and members of the SME section of the Chamber of Commerce in Hajdú-Bihar County. The questionnaire could be filled in an online form via the Internet (http://odin.agr.unideb.hu/rozsa/kerdoiv) and was also sent out in a printed as well as electronic form. Approximately 600 invitations to fill in the questionnaire were sent out by e-mail or by post. The rate of response to this request was 16%. 96 % of the respondents come from small and medium sized businesses. The processing of the questionnaires sent back revealed that 45 % of the respondents used integrated ERP systems and 43 % of them indicated that they used standalone systems while the ratio of the ones

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using both integrated ERP and standalone systems as well was 4%. The remaining 12% do not use and do not plan to implement any information systems. As regards the developers of the systems 39% of the respondents credited Hungarian developers with the system while 14% thought they were foreign developments. Among the foreign developments SAP, AXAPTA, Microsoft, Abas are named while Cobra, Topinfo, Agroorg are Hungarian developers.

The processing of the response to the question attempting to assess the ways computerised information systems were selected showed an interesting picture (Figure 1).
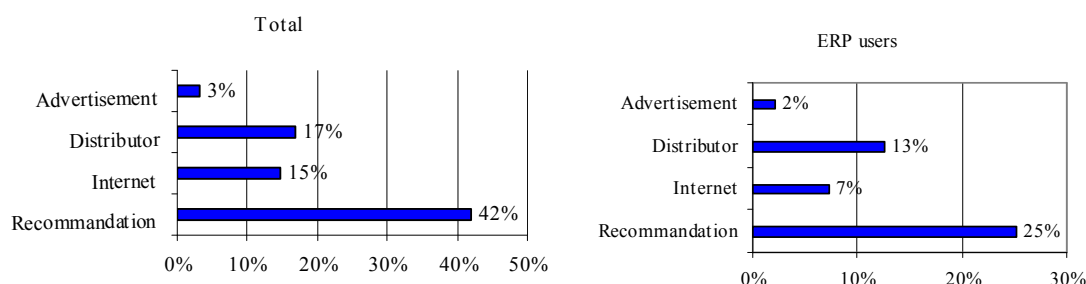

Figure 1: Ways for selecting ERP systems

Own sources, 2007

Most businesses chose or would choose ERP systems on the bases of recommendations. It is surprising, however, that there were very few respondents who – based on their own statements – would also check the recommendation on the Internet.

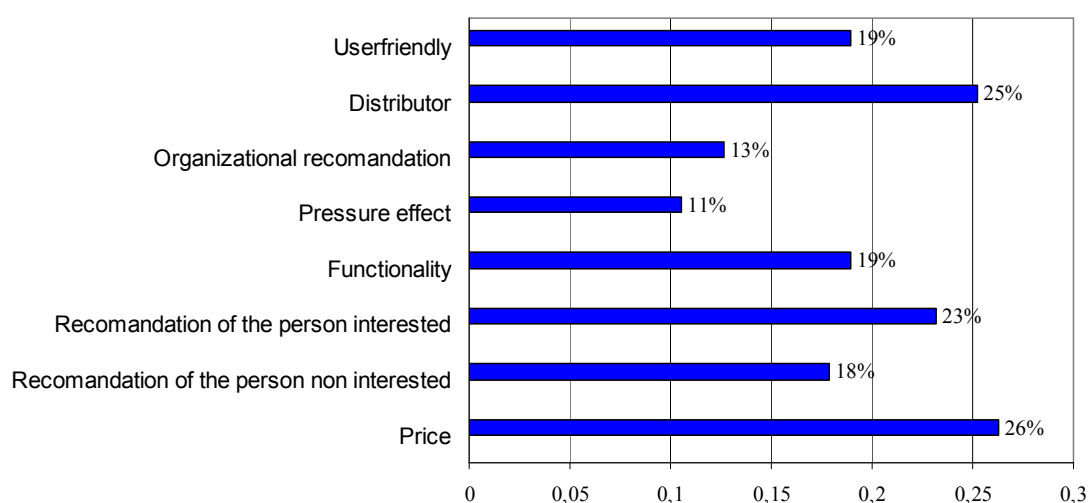A next question concerned the importance attached to certain factors in choosing ERP systems.

Figure 2: "Extremely important" factors influencing the choice

Own sources, 2007

The respondents attached crucial importance to the price of the program (26%), the goodwill / reputation of the company supplying the program (25%) and the recommendation of the

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person interested in the activities of the company (23%) (Figure 2). Having examined these three factors it can be seen (Figure 3) that the majority of the respondents (63% -75%) listed the factors analysed in one of the categories of importance.
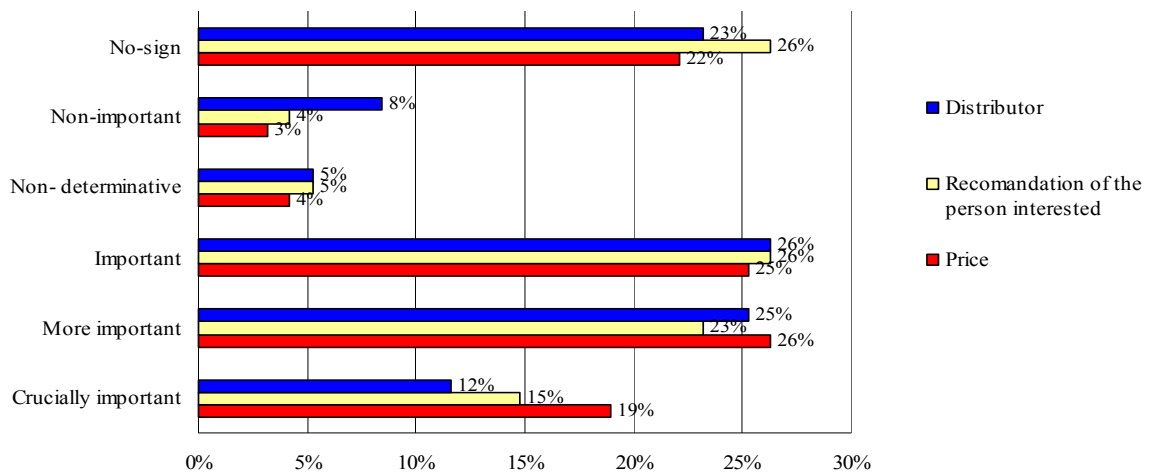

Figure 3: Judgements on the three factors considered to be crucially important

Own sources, 2007

10% of the operators of ERP systems are small businesses with staffs of up to 11 people employed by the business. Another 32% of the respondents, who also operate ERP systems, have employed staffs of between 11 and 50 and revenues of HUF 500 million - 1 billion. The distribution of ERP system operating businesses according to workforce numbers and revenues is shown in figure 4.
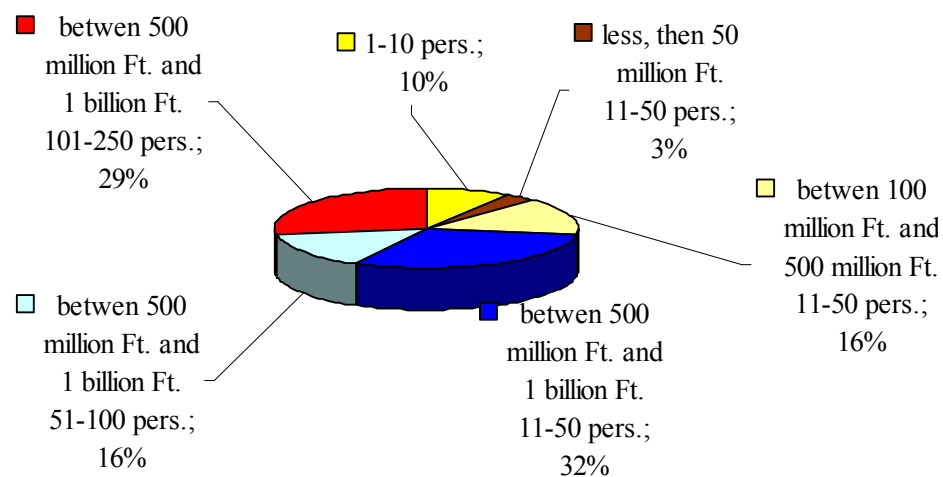

Figure 4: Distribution of ERP operating business according to sizes

Own sources, 2007

In connection with the survey the spread of the different modules was also tested together with the ones that are about to be introduced or are not used at all and the ones the introduction of which is not at all envisaged. As regards the modules in use the ratio of those

dealing with finances, general ledgers, inventory handling and tangible fixed assets are overwhelming (figure 5).
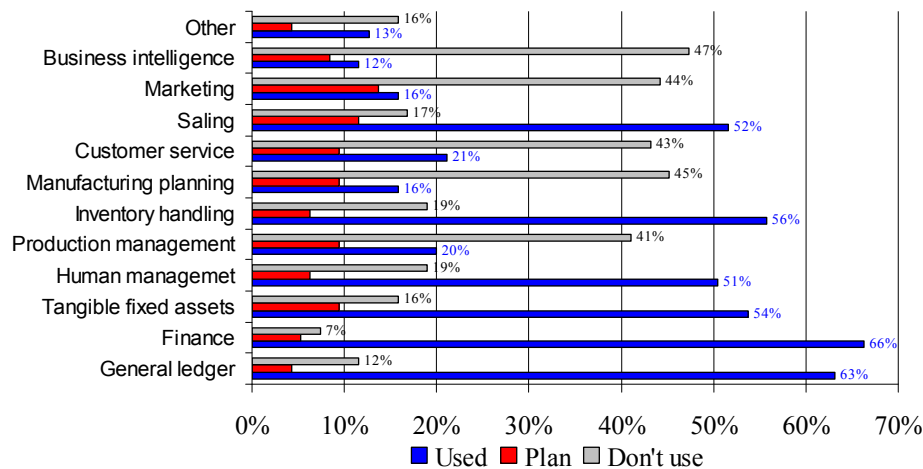

Figure 5: The use of ERP modules

Own sources, 2007

If, on the basis of the survey, the task were to choose the most important advantages that can be realised by implementing ERP then the most important advantage would be that following the implementation, obtaining information required less time and expenses. Faster flow of information also won a good place together with business procedures being more easily traceable and increased efficiency (figure 6).
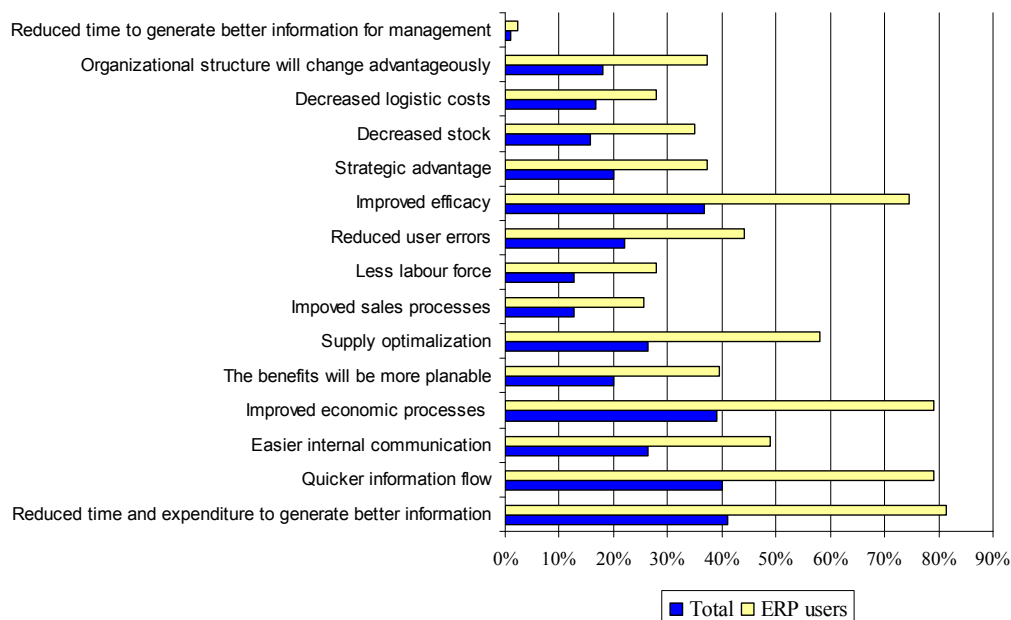

Figure 6: Advantages of the implementation of ERP

Own sources, 2007

The effect of subsidies on the implementation of the system was also analysed. 21% of the respondents used subsidies while 6% did not know of this opportunity and another 6% did not make use of them for various reasons, such as: there were no available subsidies at the time

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the system was implemented or the administration of the subsidies took months. 29% of the respondents indicated that they would not undertake the ERP investment without subsidies.
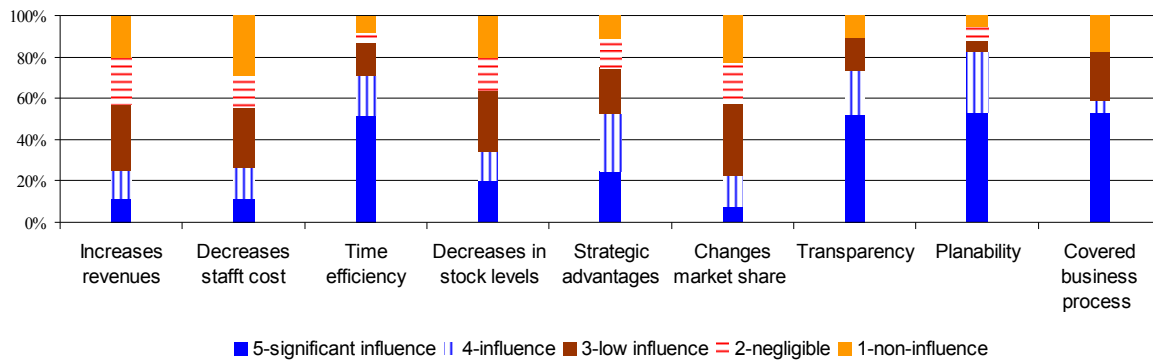

Figure 7: The effects of the implementation of ERP on different areas of economy

Own sources, 2007

As regards this research an important question was where, in what areas of businesses returns of ERP investments could be measured (figure 7). On the basis of the responses the following order can be set up: time efficiency, strategic advantages, transparency, decreases in stock levels, planability. In the chapter on economic evaluation the ways for quantifying certain factors in the case of a given project is dealt with in more detail.

3.2. Decision supporting tools assisting in choosing and evaluating the system

3.2.1. Services assisting pre-selection (ERP$_{Select}$)

The data from my own survey revealed that recommendations, especially recommendations from people interested in the operation of the business, greatly influence the opinions of those wishing to implement ERP systems. In many cases it is these recommendations that mean the first selection. In my opinion the first selection should be done on the basis of the functionality of the different ERP systems. By studying different foreign sources it can be concluded that there are tools suitable for making the first step in the selection process. Following the steps laid down at http://erp.technologyevaluation.com/ a list can be obtained about both the ERP systems suitable for my business and their comparisons. The service is free up to the point of making the recommendations but the comparison of the systems is a fee-charging service.
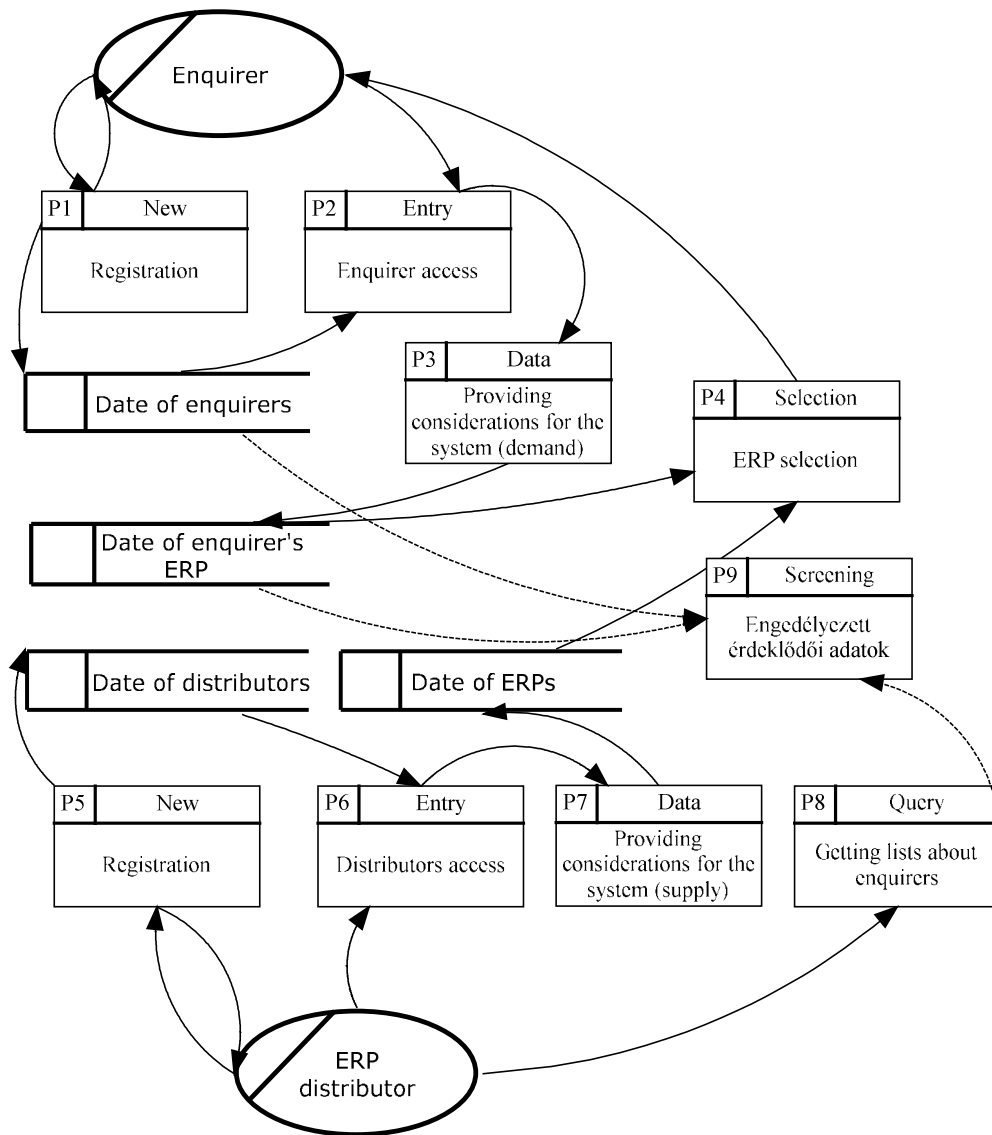
Figure 8: A sketch for thedataflow-chart of the application assisting selection

Own sources, 2007

As part of my own research a plan for an application supporting pre-selection was prepared for small and medium sized enterprises, the demo version of which was also implemented. The primary obstacle to making the service publicly available was that only few companies selling ERP solutions that had been invited to participate filled in the questionnaire, which would have formed the primary basis for selection. These questionnaires were also sent out in an electronic form. There are hopes that supported by some marketing activities there will be opportunities in the future to create the necessary database.

The sketch for the data flows of the ERP$_{Select}$ service are illustrated in figure 8.

At present the demo version stores the necessary data in four databases:

- Databases storing user data
  - Data of people making enquiries (people looking for something)

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   o Data of those offering ERP solutions (suppliers)
- Databases linked to ERP systems
   o The database storing the system requirements of those looking for ERP systems
   o The database storing the data of the ERP systems on offer.

The basis for the selection process is consists of a well-defined system of different criteria. As regards the ERP$_{Select}$ processes there are three different functions to be identified:

- Providing user data, registration (both supply and demand sides)
- Providing the considerations for the system (both supply and demand sides)
- Doing the selection, information on the results.

From the point of view of the interested person, the person trying to find ERP solutions, the ERP$_{Select}$ operates in the following way:

- Registration and entry
- Giving the criteria in ten steps.

After the data have been given the ERP$_{Select}$ selects the solutions that are the most favourable for the enquirer from the ERP database.

The involvement of ERP distributors is considered to be important in order that our database containing ERP systems and businesses selling ERP systems have as current information as possible and so be able to help small and medium sized businesses with more up-to-date information with making their choices as regards selecting systems for themselves.

3.2.2. *A decision supporting tool capable of evaluating ERP (ERP$_{Compare}$)*

The basis for the multifactoral evaluating system is the creation of some multidimensional system of considerations or criteria, which in turn will give the basis for evaluating the system. the advantage of the system is that factors that are hard to quantify can also be included in the selection process or the evaluation, while its disadvantage is that there are no standards available for creating the system of criteria, these may change individually and the expertise of several specialists is necessary for comparing them.

It is practical to include the considerations into several groups.

- Exclusive considerations: basic requirements
- Listing considerations: desirable characteristics.

When compiling the system of considerations one can rely on well-known methodologies like Euromethod ISO/IEC 9126. In conformity with the system of considerations the quantifiable

weight of each consideration also has to be defined. With the help of the preference matrices established by comparing pairs or groups of the evaluation considerations individual weighed systems of considerations can be given, with the help of which the satisfactory decision regarding the investment can be made. The method is remarkably useful in analysing implemented investments as well.

In the course of conducting this research the multifactoral evaluation model for small and medium sized enterprises published in his doctoral thesis by P. Michelberger in 2004 was also amended. The decision supporting tool developed in this research is suitable for comparing two potential ERP projects. The model was given the nickname ERP$_{Compare}$ referring to the fact that here we speak of an evaluation system supporting the selection of ERP systems.

When the model was developed the evaluation considerations were arranged according to hierarchical subordination. On this basis the model includes main considerations, considerations and sub-considerations. Within the model itself there are three main considerations differentiated, namely:

- User main consideration
- Economic main consideration
- Main consideration related to the evaluation of suppliers.

All the three main considerations were further divided into considerations, which again were divided further and sub-considerations evolved. For the purposes of a comparative evaluation a model should have the following data (these cells are indicated against a white background in the model):

- Weighing level I belongs to the main consideration. The total value must be 100%.
- Weighing level II belongs to the considerations given at the second level of hierarchy.
- There are weighs belonging to the considerations given at the third level of hierarchy.
- Score requirement means the minimum number of points required in connection with any system. Values have to be given only for the third level of hierarchy as the points pertaining to considerations and main considerations are calculated by the program itself.
- Max. Score means the maximum number of points belonging to the individual considerations. Values have to be given only for the third level of hierarchy as the points pertaining to higher levels are calculated on the basis of these inputs.
- Scores belonging to projects A and B. Values have to be given for the third level of hierarchy only.

It is to be noted here that scores can be ordered to the individual projects if some previous information or knowledge have been obtained regarding the given system and the suppliers. It follows from this that the $ERP_{Compare}$ resource can only be used in the second phase of selection. The model can be supplemented at any time by including new considerations or projects if one should use it to evaluate several solutions.

Figure 9 contains a diagram which illustrates the considerations pertaining to user main considerations in the case of an A and a B project. The evaluation remains simple as long as either one of the two projects is dominant. Looking at considerations "Supplier undertakings following system implementation" and "Functionality" in figure 9 the question as to which consideration is worth more can be asked. The evaluation according to sub-considerations may be helpful in making this decision.
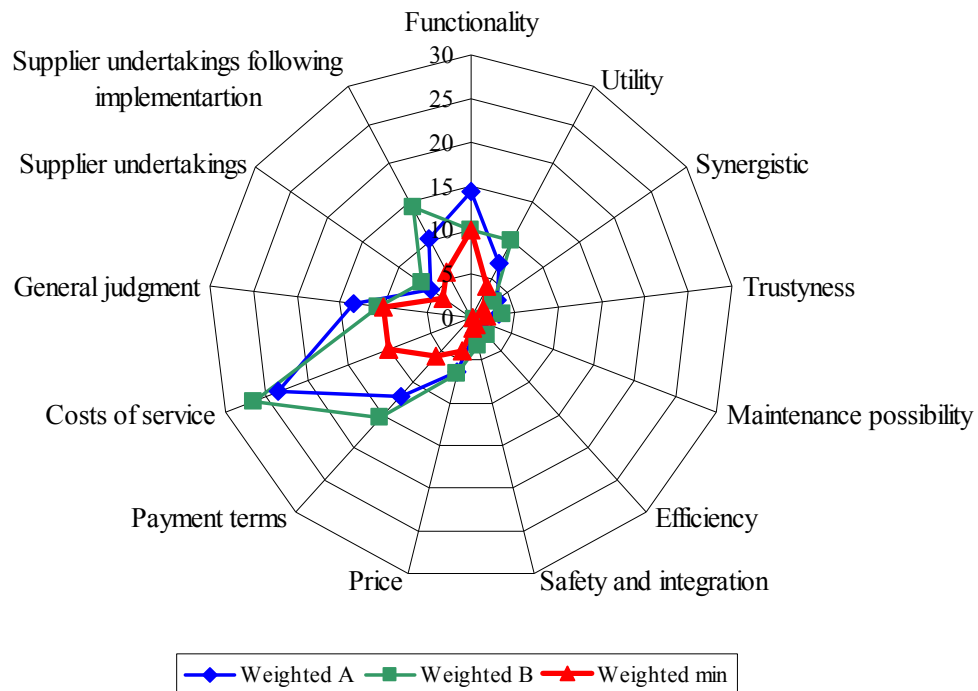

Figure 9: Evaluation according to user main considerations in the $ERP_{Compare}$ model

Own sources, 2007

By applying $ERP_{Compare}$ the sequencing of the potential solutions can be attained, which in turn helps with making selection decisions. Another practical use is that before this investment is made potential ERP suppliers can be asked to compile their tender proposals according to these considerations and so conducting the evaluation work will become easier later in the decision-making phase.

3.3.Economic analysis of Information systems

In the opinions of businesses selling ERP in Hungary today decisions concerning the implementation of ERP systems are made along two lines basically. One of them is functional suitability and the other one is the purchase price. Of course these two factors are far from being satisfactory to make a good decision and so in a certain number of cases it is already in the implementation phase that the suitability of the chosen product is found out. In such a case, however, the project can be stopped and restarted in exceptional cases only. Of course, such a case entails considerable expenses and an increase in the distrust of the company's employees, which in turn will also make the implementation of subsequent projects more difficult.

3.3.1.   Indicators used in the process of analysis

TCO (Total Cost of Ownership)

One of the simplest indicator and at the same time the one that influences business executives to a great extent is what is called **TCO (Total Cost of Ownership).** Total cost ownership means the total ownership costs of an informatics investment. The TCO indicator includes all the costs that were incurred by investing in and maintaining the equipment during its useful lifetime at the business beginning from the ones related to preparing the decision.

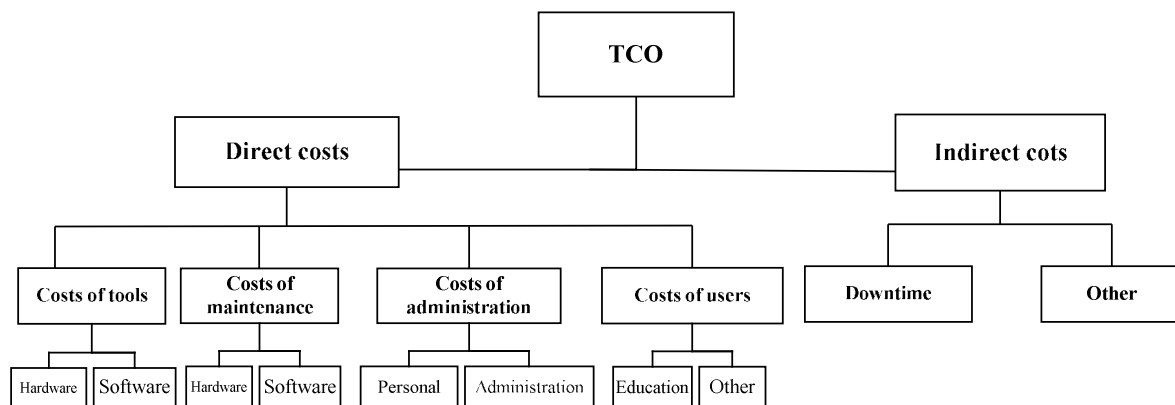The TCCO model used for calculation the total ownership cost is shown in figure 10.

Figure 10 Calculation of the TCO indicator

source: prepared by myself, 2006

Public ROI (Public Return on Investment)

This methodology was developed by the Center for Technology in Government at the University of New York with the assistance of SAP. Making efforts at integrating economic processes is one of the primary efforts a business will make. Arranging the economic processes into a system may be one of the consequences of an IT supported investment. The ROI indicator, which is suitable for measuring effectiveness and economic efficiency, is considered by business executives to be one of the most important elements in decision-

making even in our days. The ROI i.e. the indicator of the return on investment is the most frequently used indicator in IT investments. It shows what percentage of the invested capital is constituted by the "profit" resulting from the investment. The integration of processes is a complex issue for the evaluation of which a number of factors are to be taken into consideration in founding a decision. Investments can be evaluated by making use of different ROI indicators. We can also speak of general ROI (ROI), arithmetic ROI (ROI_{arit}) and logarithmic ROI (ROI_{log}).

Calculating the ROI for [*0,k*] period:

$$ROI_k = \frac{H_k}{I_k},$$

where

ROI_k –is the general ROI for the period [0,k],

H_k - is the profit accumulated over period [0,k] as a result of the investment,

I_k – is the capital invested over period [0,k] for the implementation of the investment.

Net present value

In analysing and evaluating an investment one of the most frequently used indicators is **net present value, NPV.**

It is calculated as follows:

$$NPV = -C_0 + \sum_{i=1}^{n} \frac{C_i}{(1+r)^i},$$

where

C_0- means the capital invested in order to realise the investment,

C_i- means the net cash flow for period i as a result of the investment,

r - means the discount rate,

n - means the analysed service life of the investment.

The cash flow for a given period can be calculated as follows:
$$C_i = B_i - K_i,$$
where
B_i – is the total of the incomes over period i,

K_i – is the total of the expenses for period i.

In calculating the NPV the incomes realised and the expenses incurred can be taken into account. The registration of an event in the accounting system can be used in calculating the NVP only after the correction has been made.

3.3.2. *The decision supporting tool (ERP$_{Eco}$) developed for the evaluation*

For those wishing to implement the ERP system, for the businesses dealing in it and also for the purposes of the analyses to be conducted within the framework of this research a calculator system was developed, in which an ERP system implemented can be evaluated according to the evaluation processes, methods and indicators mentioned in the previous points. This calculator system was named ERP$_{Eco}$, which refers to the economic evaluation as its main function. The ERP$_{Eco}$ does calculations for a period of up to ten years. Its structure is illustrated in figure 11.
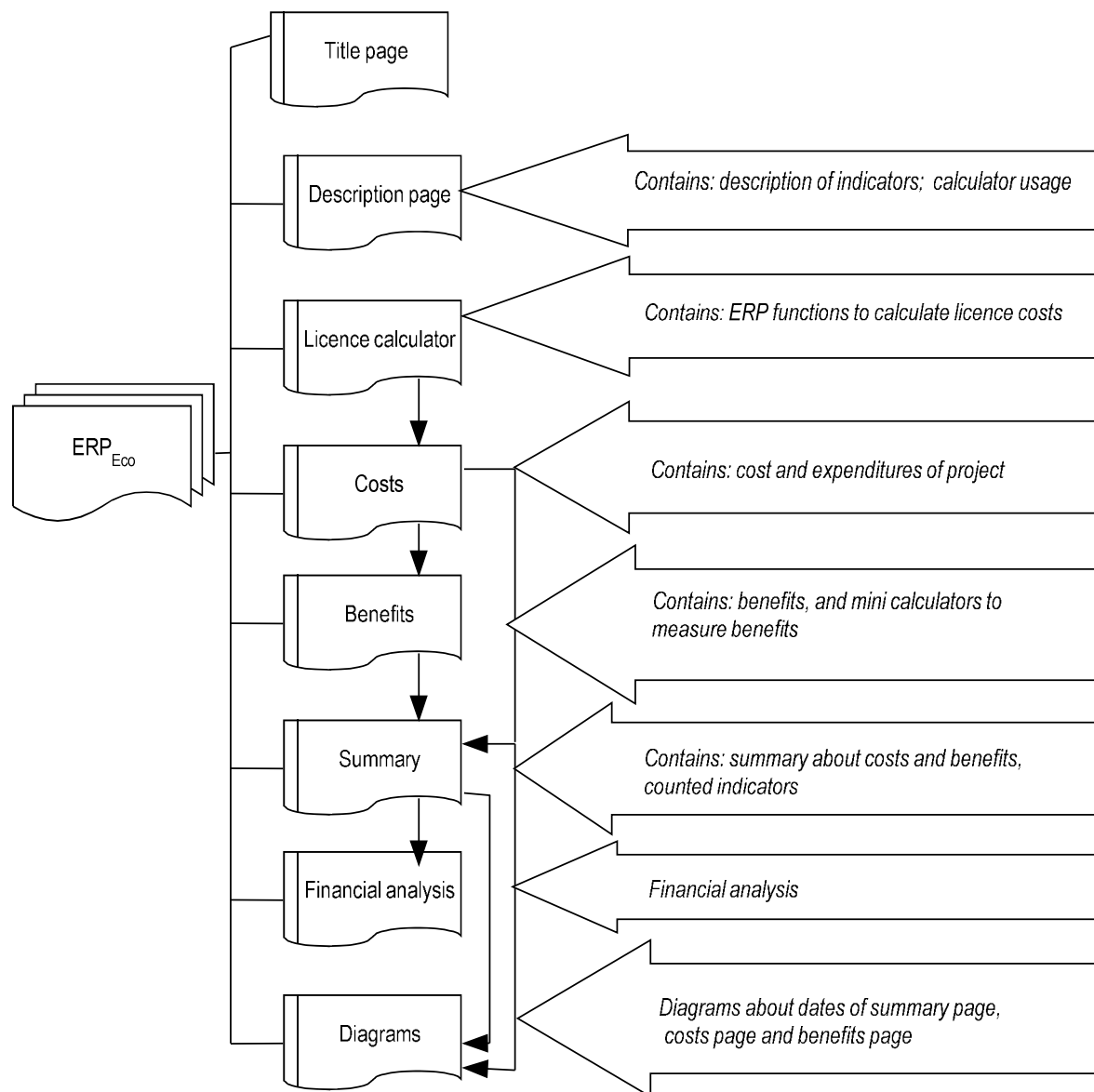

Figure 11: The architecture of ERP$_{Eco}$

The licence module contains the most important functions included in a module system. If the proposals are made according to these modules, the calculator can be easily used to make decisions concerning implementations or even to evaluate the effects of later extensions.

The ERP$_{Eco}$ operates by using certain basic financial data, such as:

- Expected returns
- Discount rate
- Average tax bracket.

An important step in the evaluation of ERP systems is the thematic collection of the data necessary to calculate the indicators. Two important groups were defined in this respect:

- Expense
- Earnings.

Expenses mean all the economic activities linked to paying out any sums of money that may be related to the ERP investment.

The definition of the earnings is a little bit more complex. Any incomes and savings directly or indirectly related to the introduction of the ERP system are listed here. After the Expenses and earning have been quantified the necessary values are totalled in the module "sum total" and the preset calculable indicator figures are computed (figure 12).

ROI- direct and indirect	**202%**
ROI (direct)	**148%**
NPV (direct and indirect)	**66 876**
NPV (direct)	**69 603**
Payback period	**<3**
Avarage anual TCO	**5 917**
Discounted avarage anual TCO	**5 550**
10-years IRR	**76%**
TCO	**59 174**

Figure 12: The financial indicators are computed

Own source, 2007

The indicator TCO is illustrated in the module 'diagrams' together with the distribution of earnings, the distribution of the total expenses (figure 13), a comparison between the expected and the realised results and the trend in net present values at different discount rates.

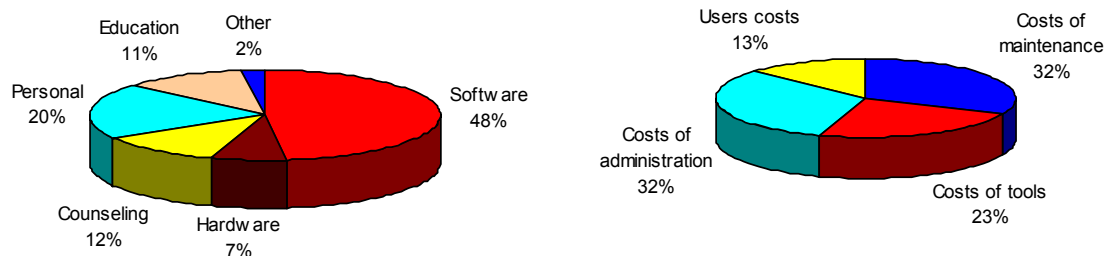| TCO	59 174	Total cost	59 174
Costs of maintenance	18 660	Software	28 480
Costs of tools	13 867	Hardware	4 047
Costs of administration	18 712	Counseling	6 992
Users costs	7 935	Personal	11 720
		Education	6 685
		Other	1 250

Figure 13: The TCO and the distribution of the total expenses

Own source, 2007

3.4. Evaluation related case studies

There were several project evaluated by using ERP_{Eco}, out which three arguably different cases are cited as examples. The first case study was prepared in relation to the implementation of an ERP system at a medium sized company, while the second case study evaluates the solution package of an accountancy firm and the third one evaluates a mobile application introduces as a supplement to a business management system.

3.4.1.   Evaluation case study: The implementation of an ERP system at a manufacturing plant

The business in question conducts product manufacturing and „infor.COM" and „infor.Finance" company management systems were implemented in 2006-2007. Before the introduction of the systems they had had standalone applications for bookkeeping, managing finances and inventory stocks. The company employs about 120 staff and operates as a subsidiary of a German parent company. Most of the products manufactured are for the German parent factory. This puts more and more burden on the subsidiary as the parent company requires monthly reports each month and four-weekly financial plans every week. On the other hand, due to the same reasons retaining customers and observing customer demands are not of a strategic importance either.

The indicators calculated from the given expenses and earnings are shown in figure 14. The ROI indicator is 36%, provided both the direct and the indirect earnings are also taken into account. I. however, only the direct earnings are considered, it shows 40%. Since both in the

direct and the indirect categories a careful estimation was used, the investment can be claimed to generate extra earnings over a ten year period. This is also supported by the fact that the NPV also has a positive value. The investment returns in the eighth year. Considering the costs of ownership it can be concluded that the investment cost is HUF 5,036, which is of course higher in the initial period but is levelled out later on.

ROI- direct and indirect	**36%**
ROI (direct)	**-40%**
NPV (direct and indirect)	**3 035**
NPV (direct)	**-19 428**
Payback period	**8-ik évben**
Avarage anual TCO	**5 036**
Discounted avarage anual TCO	**4 745**
10-years IRR	**16%**
TCO	**50 362**

Figure 14: The indicators calculated in the First Case Study

Own source, 2007

The internal rate of return over the ten year period shows 16%, which compared with a usual 10% interest rate, reveals that the investment proved to be a good decision.
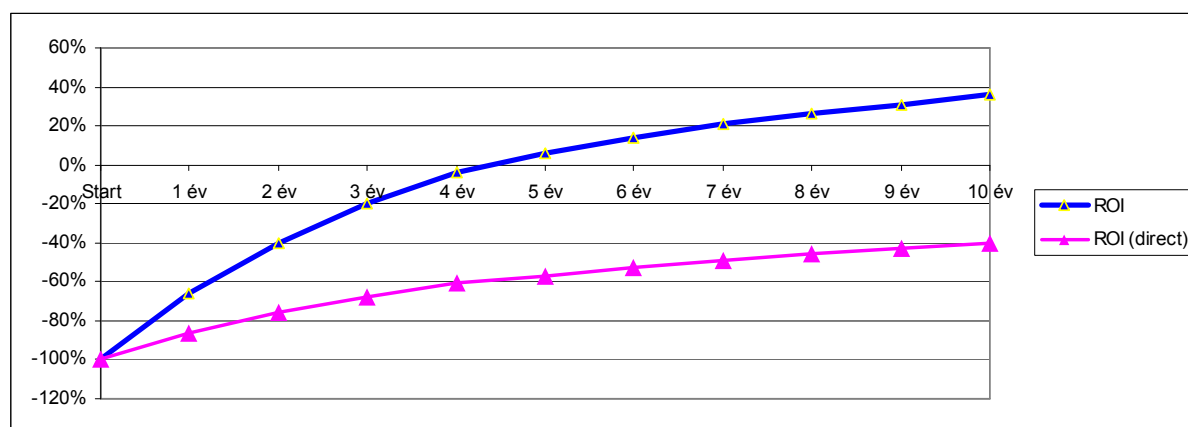

Figure 15: Direct and indirect ROI in the First Case Study

Own source, 2007

Examining the yearly variations in ROI (figure 15) it can be said that if the discount factor is not considered, the ROI for the investment becomes positive in the fifth year already. The increase in ROI becomes smaller and smaller and both the full ROI and the direct ROI produce logarithmic increases.

It is also worthwhile analysing the shaping of the NPV over the ten year period. In contrast with the ROI indicator here the discounting factor was taken into account. The consideration of this discounting factor entails that the NPV becomes positive only in the eighth year (figure 16). Since the development of the NVP shows an increase in the subsequent years too the

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NPV does not return into the negative domain. For this reason the eighth year is considered as the year when the investment is returned. The Direct NPV shows a slight decrease.
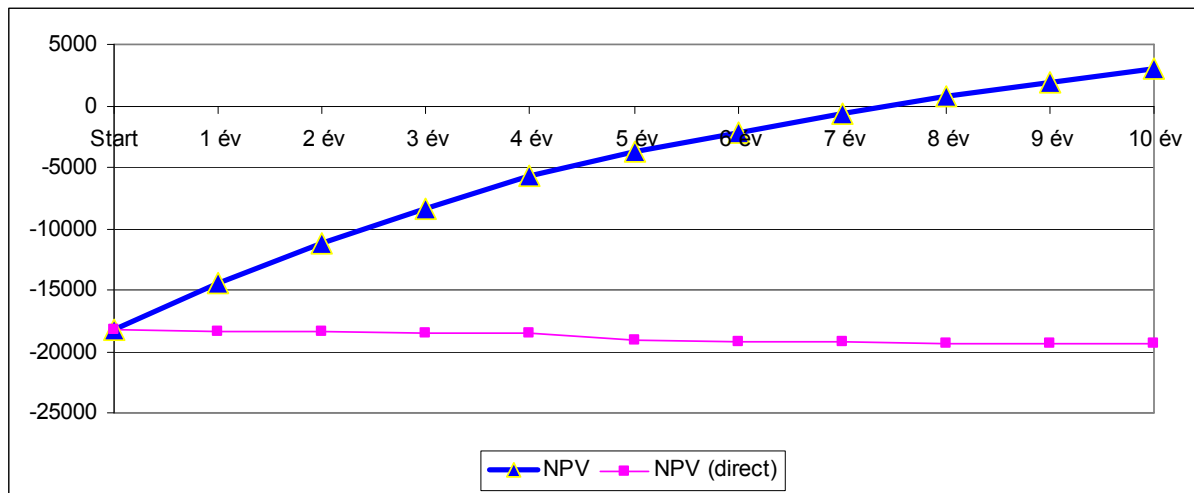

Figure 16: The development of the net present value in the First Case Study

Own source, 2007

Depending on the defined level of the discounting factor, the changes in the NPV for the investment may become important. These changes are illustrated in figure 17 at different discount rates. It can be seen that at a discount rate of 16% the net present value of the investment gets very near 0.
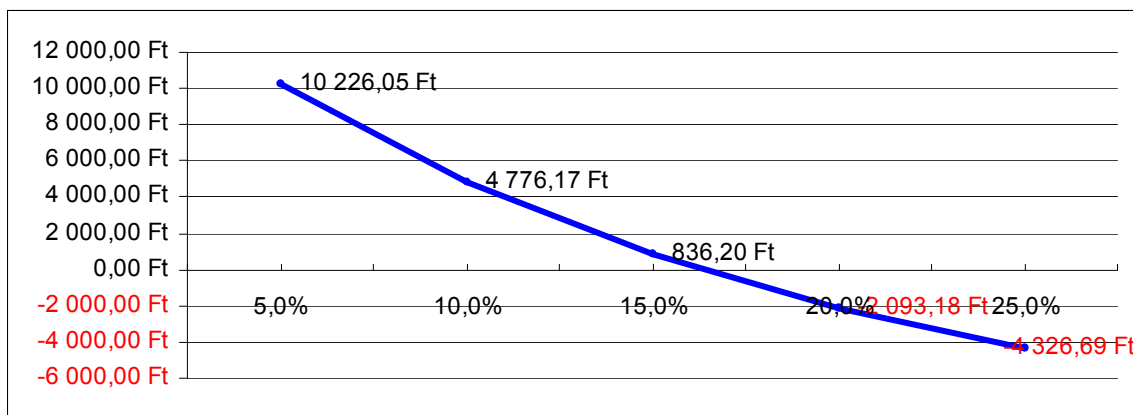

Figure 17: The development of the NPV at different discounting factors in the First Case Study

Own source, 2007

All in all it can be said that the real benefit of the investment is in the traceability of production processes, the optimisation of the organisational structure and in the real-time traceability of materials and goods. The evaluation reveals that the investment involves a high number of hazards and if the instability of the economy continues, the inflation or the interest rate increases, it is highly probable that the investment will not be profitable.

Studying the evaluations of similar systems the claim can be made that their return period is between one year and four years. The differences are largely due to the fact that when the

issue of the categories of earnings was brought up, the answer was that this question would not emerge. This means that the expenses' side is clearly identified whereas the income side remains far from perfect, at least this is my opinion. Even in the second year of the implementation the company faced a number of problems and the services of the system could not be used as fully operational.

3.4.2. *A sales case study ERP implementation with financial, accounting and payroll calculating modules*

The main activity of the business investigated is accounting. It has two full-time employees. Their old system was a DOS based bookkeeping program that had to be updated every year. Payroll calculation was done and tangible asset records were kept in excel tables. In 2006 an integrated financial, accounting, tangible asset recording and payroll calculating module was implemented that can handle and manage the administrative processes of several businesses. The yearly income of this business is HUF ten million.

The main objectives of the implementation were as follows:

- The integration of processes, doing away with extra recording tasks

- Opportunities for making queries more easily, even in an electronic file

- The support of filing tax returns in an electronic format.

The initial assumption was that the investment would pay off shortly. The advantage of the investment is that operating computers is not a problem for the users and so the program can be learned relatively easily.

It can be mentioned of the project that the calculated ROI indicators (both direct and indirect) showed high values (figure 18). The ROI value of 427% shows that the investment will return four times over the ten year period investigated.

ROI- direct and indirect	**427%**
ROI (direct)	**405%**
NPV (direct and indirect)	**18 013**
NPV (direct)	**24 603**
Payback period	**<3**
Avarage anual TCO	**781**
Discounted avarage anual TCO	**730**
10-years IRR	**159%**
TCO	**7 807**

Figure 18: Sales indicators in the Second Case Study

Own source, 2007

3.4.3. Sales case study- the implementation of a mobile supplementary application

With this project the situation was as follows: due to low direct earnings and discounting the total NPV of the investment is lower than the NPV, generated by direct earnings (figure 19).
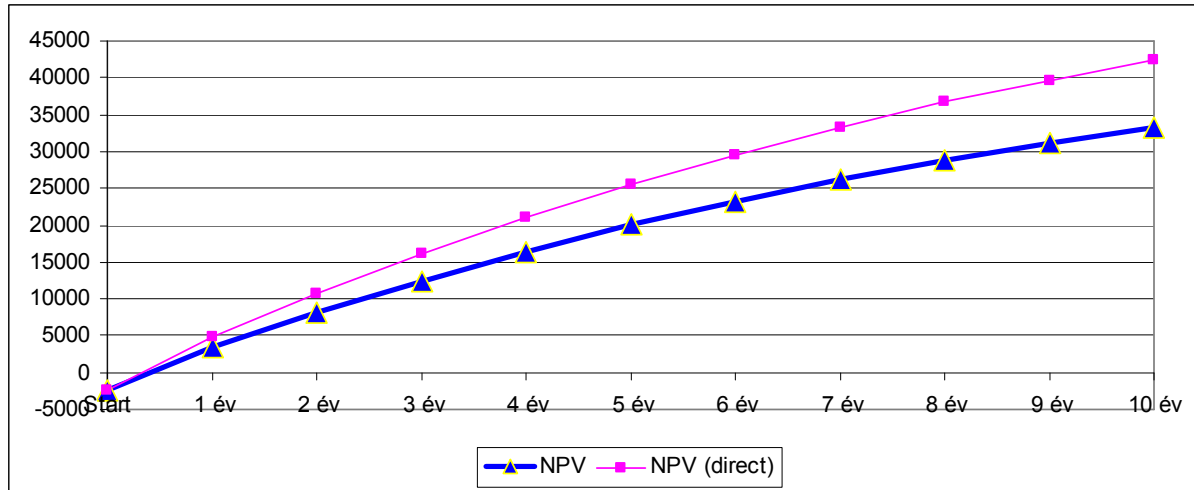

Figure 19: The development of direct and indirect NPVs in the Third Case Study

Own source, 2007

Both figures 19 and 20 show that the investment brings returns in the first year already. The development of the ROI indicator shows smaller and smaller increases along a logarithmic trend.
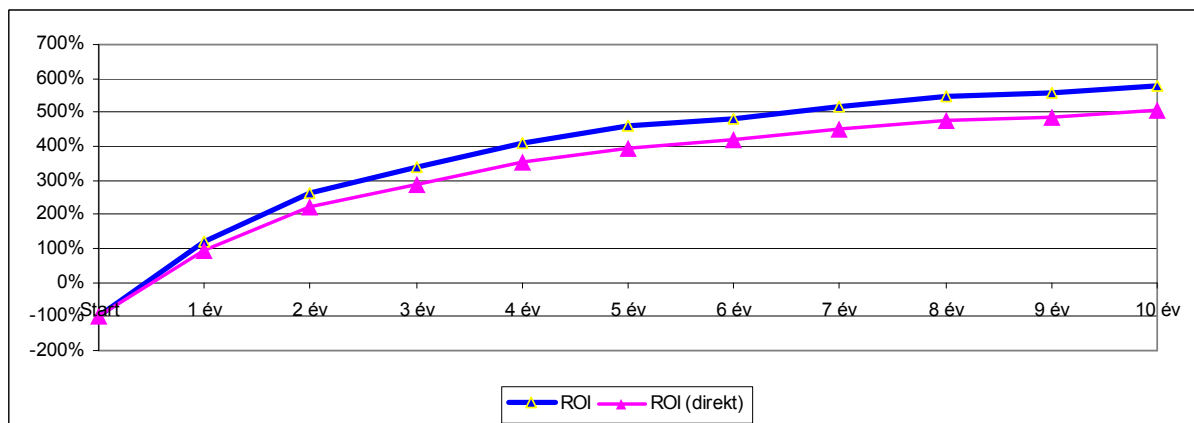

Figure 20: The developments of the direct and the indirect ROIs in the Third Case Study

Own source, 2007

All in all the investment can be said to seem to bring returns in the first year and despite cautious estimations its earnings bring the investment in a stable position which cannot be shaken even by a major change in interest rates.

3.4.4. An analysis of the effects of the system introduced on the organisations

When dealing with the case studies I did not enlarge on the measurement of the effects of the economic and market changes bearing on the basic activities. Of course any changes

influencing basic activities will greatly influence the profitability as the investment. If a builder does not receive new orders due to changes in demands on the market, however high the calculated ROI is, the crisis of the basic activity will result in the failure of the investment.

It can be emphasized that in the SME sector, out of the effects on the business the implementation of ERP changes the structure of the business favourably. The favourable change can be established from the point of view of the business itself. At the same time, a system implemented at a business may change the professional expectations for the employees at the different levels of the hierarchy. This already means a negative effect on the employees. There are cases where the resistance can be traced back to the fact that the employees are literally afraid for their jobs. The jobs done are well registered in an integrated system and the person who made a certain mistake can be easily identified. In addition, if the mistake is made at a relatively low level it can have its effect felt on the whole process, i.e., a mistake can considerably influence a whole process and can be felt in the final result even more markedly. Anyway, it can be concluded that in every case employees are counter interested in the implementation of an ERP system. The reason for this may also be the extra work to do in the introduction phase or the decreased demand for working hours resulting from integrating the different processes, which may lead to terminating some jobs.

The effect on customers is usually positive, i.e., the business show a more uniform picture of itself to its clients. Customers will feel that due to the more precisely kept records they receive more attention, their orders are executed to time, their shoppings may also be monitored and purchasing habits may be identified and if there is a new product appearing on the market, business may use direct marketing and so an attempt can be made at making the ties between the customer and the business stronger.

The effects on suppliers are mostly positive. A unified picture of the business can be seen in this case too (documents with the same contents, documents structured in a uniform way, etc.). The improvements in the discipline as regards making payments can also be called a positive effect. For suppliers delivering quality and quantity that is not up to the standard it can be a disadvantage that in an integrated system quality and precision in making deliveries can also be traced. The reason for the disadvantage is that by using an ERP system the opportunities for monitoring deliveries are enhanced both as regards quantitative a qualitative considerations. Thus suppliers performing poorly can be easily identified. This effect in turn has a positive effect on the others as the poorly performing competitors lose out.

6. NEW AND NOVEL FINDINGS, RESULTS OF THE THESIS

I would like to highlight the following results and findings of this research:

1. **On the basis of the survey conducted in SMEs it has been concluded that**

- Most enterprises choose or would choose ERP systems on the basis of recommendations. Recommandations of the persons interested in ventures have more priority in decision.

- In making the section it is the price of the program and the name of the developer/distributor that are the most important selection considerations

- The four most frequently used modules are: sales, inventory management, finances, general ledger.

- Ventures see, feel and experience the drawbacks of implementing ERP too.

- From the point of view of this research the question, as to where, in what business areas the return of ERP investments can be measured, is important. On the basis of the responses the following order can be established: time efficiency, strategies advantage,

2. On the basis of a multifactoral evaluating process a **decision supporting tool (ERP$_{Select}$)** was developed. The considerations in the model were divided in three groups: *User considerations, Economic considerations, considerations related to supplier evaluation.* Each group was further broken down into sub-groups and the sub-groups include the considerations. Weigh levels and weighs were also incorporated in the model so the importance of a given group, sub-group or consideration can be given at each level of the hierarchy. The evaluating process was developed in an excel spreadsheet.

3. A **pre-selection supporting application (ERP$_{Compare}$)** was developed for small and medium sized businesses. The demo version for enhancing the selection process was developed on an Internet interface.

4. For businesses and wishing to introduce the ERP system and distributors as well as for the purposes of the investigations within this research there was a **calculator system capable of supporting decisions (ERP$_{Eco}$)**, developed, in which ERP system introduced can be evaluated through different financial and economic evaluation processes.

5. For the **evaluation and practical applicability** of ERP$_{Eco}$ and business analyses in practise there were three case studies prepared together with detailed analyses.

7. PRACTICAL USEFULNESS OF THE RESULTS AN FINDINGS

As regards the results and findings of this research the following practical utilities are to be highlighted.

- The multifatoral evaluation model suitable for comparing ERP systems, which was developed within the framework of this research, can be used in practice by small and medium sized businesses for comparing two or more ERP systems judged according to their functions to be functionally suitably so that all the systems could be judged according to the same objective criteria.

- The usefulness of the calculator system developed was proved through the case studies. In practise, the calculator system is suitable for economic evaluations of ERP systems both before and after implementation. This calculator is available in an Excel file format at this moment but there are plans for developing an operation program variant and a simplified internet format with a web version.

- The surveys, the case studies and the conclusions drawn can be made use of for distributor and user businesses alike.

8. PUBLICATION IN THE SUBJECT OF THE RESEARCH

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