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ERP SYSTEMS IMPLEMENTATION EFFICIENCY MODELING IN SMALL AND MEDIUM SIZE ENTERPRISES (SMEs)

Abstract

An original method of ERP in SME implementation efficiency assessment (EWE) is developed. It consists of 5 elements, that is: (1) ERP system parameters, (2) SME company parameters, (3) an SME experience which proceeded the ERP project, (4) functionality indicators values, (5) an algorithm that enables ERP and SME characteristics binding – a GMDH algorithm. The application of this method allows predicting economical effects as far as the implementation of ERP is concerned, taking into consideration efficiency indicators in the analyzed company. On the basis of the EWE method, a decision model for ERP efficiency implementation has been developed.

1. INDRODUCTION

IT project investments play a strategic role in companies because they greatly influence the organizational structure of a company. Therefore, the projects must be properly prepared and implemented in accordance with the strategy, as well as properly managed. IT investment analysis methods along with estimation techniques and project control enable the management to determine an economical strategy.

The dynamic development of ERP systems witnessed in the recent decade together with their growing sale increase provide the best evidence for the fact that the systems are in demand as a supporting tool in management [1]. Bearing in mind the needs of the market, IT developers customize ERP functionality to SME demands.

SMEs that are to make a decision concerning the introduction of an ERP system tend to make a pre-evaluation of the efficiency of the very implementation (for example, taking into consideration the level of the user's objectives realization) [4]. However, the process of efficiency evaluation is very expensive, time consuming and followed by complicated analyzes, which means that companies tend to opt for any products, which are not really adjusted to their needs. Bearing this in mind, there is a demand for developing a method that would diminish the risk of inadequate implementation and, at the same time, allow solving problems which could otherwise be missed. A relevant framework for this issue is based on a

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database referring to the following situation: there exists an SME, defined with selected functionality indicators, and an ERP system (*SAP Business One* or *Comarch CDN XL*) ascribed to the SME as well as to a company module of the SME. Is there a method allowing assessing the effectiveness of ERP implementation in the SME?

Developing the decision model for ERP implementation in an SME stands for the possibility of searching for process objectification, including the assumed costs and existing limitations in resources [7]. The problem is really boiled down to finding a tool that would be orientated towards ERP system implementation support.

The decision as far as ERP implementation is concerned is based on the assessment of the potential advantages, resulting from system operation in the company. Despite the attempts that have been made by ERP systems developers (SMEs offer customization), it is difficult to meet the users' demands. So it can be observed that there is "market vacuum" for tools orientated towards IT implementation support systems for company management. A key task in this paper would be to find a good IT supplier so that the company would meet the objectives previously set.

It can be concluded that there is a need to define the criteria of ERP system efficiency in SMEs, which should be carried out on the basis of the functionality area definition. Consequently, an appropriate reference model of the company should be developed to facilitate both defining the needs in the areas of functionality and successful evaluation of ERP implementation. Such a model should provide a kind of guideline for the future ERP implementation framework. The decision concerning the selection of the proper ERP system should be preceded by management profitability assessment of the prospective advantages of system implementation [5].

In order to view the prediction of selected functionality indicators, original consulting ERP implementation prediction (software consulting IT system for ERP implementation effects in small and medium size companies) can be used [9].

In this paper, an original method for ERP in SME implementation efficiency assessment (EWE) in small and medium enterprises (SMEs) and a model of ERP selection for an SME are presented.

In order to analyze the methods (based on the value) of IT in SME implementation efficiency assessment, it is necessary to find a method of ERP in SME implementation efficiency assessment which would allow predicting economical effects as far as the implementation of ERP is concerned, taking into consideration efficiency indicators in the analyzed company.

2. METHODS (RESTING ON VALUE) FOR IT IN SME IMPLEMENTATION EFFICIENCY ASSESSMENT

2.1 Total Cost of Ownership - TCO

By IT implementation can be defined Additional Capital Costs (software, IT support software and network infrastructure, Technical Support Costs (hardware and software deployment, help desk staffing, system maintenance), but can not be estimate End-user Operations Costs (the costs incurred from downtime and in some cases, end users supporting other end users as opposed to IT technicians supporting them, which can be very costly).

Total Cost of Ownership (TCO) is a concept by which all costs associated with a capital purchase over a given time period are accounted for in the value assessment. It can also be

thought of as the cost of owning and operating an existing asset at a given point in time [2]. Both are useful in optimizing asset ownership. Every organization that uses technology, no matter what size, can benefit by viewing IT expenditures from a TCO perspective. This means looking beyond the costs of the end-user hardware, and considering other associated costs such as the following (Fig. 1).

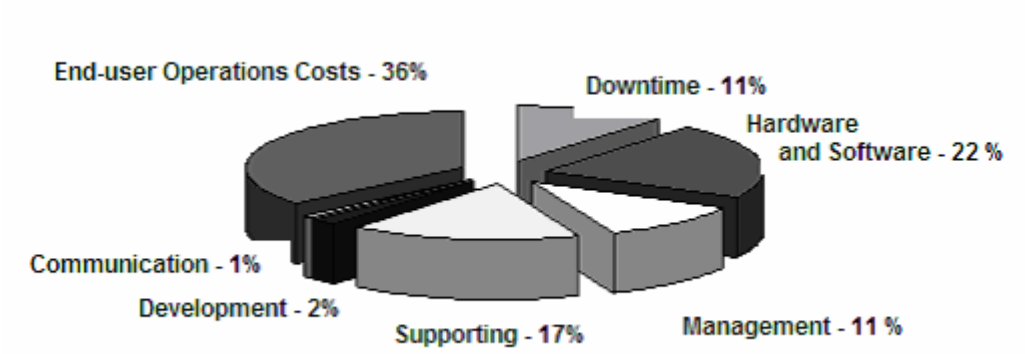

Fig. 1. The cost in the enterprises in TCO

In the praxis is defined two points in TCO:

- Analysis of accountant date,
- Modeling and analysis of business processes.

The analysis TCO begins with the design of a comprehensive cost model that completely covers the subject of the case, and which supports the purpose and needs of decision makers. The figure above, for instance is the structure of an IT acquisition cost model that works well for many situations.

The model provides an effective tool for assuring business case builders and case recipients that every important cost item is included and that everything irrelevant is excluded.

TCO analysis is not a complete cost benefit analysis, however. TCO pays no attention to business benefits other than cost savings (and these show up in TCO analysis only when different TCO scenarios are compared). When this approach is used in decision support, it is usually assumed that the benefits from all alternatives are more or less equal, and that choices differ only on the cost side.

2.2. Earned Value Added - EVA

EVA is a measure of the economic value of an investment or project. It is the after-tax cash flow generated by a business minus the cost of the capital it has deployed to generate that cash flow. Representing real profit versus paper profit, EVA underlies shareholder value, increasingly the main target of leading companies strategies. EVA, assumes actual amounts, and based on the inputs can help you better track efforts over time to understand how funding them is helping or hurting your overall efforts as they relate to the bottom line both financially and to your reputation [12].

Tracking over time helps to adjust the level of effort required versus the level of output needed to sustain the effort, taking into account the profit as well as the overall strategic goal of having a blog in the first place. If your blog is giving you big returns, using Earned Value

Analysis will make it easier to compare blogging efforts to other aspects of your company, thus allowing you to better decide how to manage those finite resources.

2.3. Total Economic Impact - TEI

TEI is a highly customized methodology that helps IT professionals make better, more cost-effective decisions regarding the selection of technology vendors. TEI systematically looks at the potential affects of technology investments across four dimensions:

Dimensions in TEI	Description
Cost	IT budget, IT accountability. Costs represent the investment necessary to capture the value, or benefits, of the proposed project. IT or the business units may incur costs. These may be in the form of fully burdened labor, subcontractors or materials.
Benefits	Business value - impact on business. The value delivered to the business by the proposed project. All benefits captured by TEI must be traceable back to one or more critical success factors (CSFs). These CSFs are directly linked to a higher-level business strategy. If a proposed technology investment generates benefits that cannot be satisfactorily linked to a CSF, then it will not be included as a benefit for the organization in the model. In these cases, TEI requires that the benefit be discarded.
Flexibility	Options created, future options created by the investment. Flexibility, as defined by TEI, represents investing in additional capacity that can, for some future additional desktop word processor application where the primary driver may be standardization (to increase efficiency) and licensing (to decrease IT costs). The existence of the option has a present value that can be estimated. The flexibility component of TEI captures that value.
Risk	Uncertainty. Risks are used to widen the possible outcomes of the project. Since the future cannot be accurately predicted, there is risk inherent in any project. TEI captures risk in the form of risks-to-benefits and risks-to-costs.

Fig. 2. The Dimensions in TEI, [10].

The TEI process begins with a discovery of potential benefit areas. Within TEI, each benefit entered has a specific capture date. TEI will then place the value delivered in the appropriate time frame within the project [8].

2.4. Balanced Scorecard - BS

BS is a management system (not only a measurement system) that enables organizations to clarify their vision and strategy and translate them into action. It provides feedback around both the internal business processes and external outcomes in order to continuously improve strategic performance and results. BS is used in the project management, innovation management and enterprises management [11]. BS suggests that we view the organization from four perspectives, and to develop metrics, collect data and analyze it relative to each of these perspectives:

Perspectives in BS	Description
The Learning and Growth Perspective	includes employee training and corporate cultural attitudes related to both individual and corporate self-improvement. In the current climate of rapid technological change, it is becoming necessary for knowledge workers to be in a continuous learning mode. Government agencies often find themselves unable to hire new technical workers, and at the same time there is a decline in training of existing employees.
The Business Process Perspective	refers to internal business processes. Metrics based on this perspective allow the managers to know how well their business is running, and whether its products and services conform to customer requirements (the mission). In addition to the strategic management process, two kinds of business processes may be identified: mission-oriented processes, and support processes. Mission-oriented processes are the special functions of government offices, and many unique problems are encountered in these processes. The support processes are more repetitive in nature, and hence easier to measure and benchmark using generic metrics.
The Customer Perspective	includes customer focus and customer satisfaction indicators in any business. These are leading indicators: if customers are not satisfied, they will eventually find other suppliers that will meet their needs. Poor performance from this perspective is thus a leading indicator of future decline, even though the current financial picture may look good. In developing metrics for satisfaction, customers should be analyzed in terms of kinds of customers and the kinds of processes for which we are providing a product or service to those customers.
The Financial Perspective	includes the all finance indicators. Metrics based on this perspective allow the managers to know how well their finance running. The all finansal date is based on balance, cash flow, profit and waste calculation in SME.

Fig. 3. The four perspectives in BS, [11].

It is worth defining [8] steps in building BS:

- defining the objectives in the four perspectives,
- defining the strategical steps,

- binding business process in the strategical project,
- binding the responsibility ,
- controlling results,
- defining the learning process.

Additional value for SME can be defined by an effective ERP implementation. SME with IT integrated systems is also advantageous in relation to the company contractors because it enables an insight into every aspect of its operation with a precise and correct evaluation of the company financial situation.

In order to analyze the methods (resting on value) for IT in SME implementation efficiency assessment it is necessary to find the method for the ERP in MSP implementation efficiency assessment, which could be allow for the prediction of the economical effects as far as the implementation of ERP is concerned, taking into consideration the efficiency indicators in the analyzed company.

3. METHOD FOR ERP IN SME IMPLEMENTATION EFFICIENCY ASSESSMENT + EWE

The original method was developed on the basis of the defined method for IT project profitability assessment, including ERP systems characteristics. It combines a knowledge database with an SME experience in which the project has already been implemented. It consists of 5 elements, that is:

(1) ERP system parameters,
(2) SME company parameters,
(3) An SME experience which proceeded the ERP project,
(4) Functionality indicators values,
(5) An algorithm that facilitates ERP and SME characteristics binding – a GMDH algorithm.

The name of the method is an acronym that enhances its main functionality factors, namely: Efficiency – Implementation – ERP.

In order to define the method of assessing the efficiency of ERP system implementation in an SME, it is necessary to find answers to the following questions:

(1) What kind of SME is to be discussed?

The reference model has been developed (an SME according to the regulation dated November 12, 1999, Commercial Law – Dz .U .Nr 101, poz 1178), which includes the following [6.]: the legal aspect of SME operation, SME business areas, the basic and supporting activity areas description, company efficiency assessment indicators.

(2) What parameters of the SME are to be considered?
(3) In which way is information concerning ERP in SME implementations to be accessed?

The development of the ERP decision model as far as the purchase of the system is concerned should be started by collecting as much information as possible in relation to the structure and dynamics of the object in question. It can be subjective knowledge which

involves empirical data obtained as a result of the observation of object functionality. This approach consists of complete knowledge data because it has been obtained in a real situation. The elements in the decision model (ERP parameters – the parameters of *SAP Business One or Comarch CDN XL*, the values of selected SME functionality indicators) were obtained as a result of research carried out in the area of the Lubuskie region, Poland, in the time period between January and September 2005. The data was collected in companies operating within the SME sector where the ERP system was applied, and the companies belonged to the reference model of the SME.

(4) What kind of algorithm can be used to combine SME and ERP characteristics?

For the defined object – the pair: an ERP system and an SME (the parameters of *SAP Business One* or *Comarch CDN XL*, and SME efficiency indicators), two empirical databases of SME indicators and ERP systems parameters were developed. The data containing the values of SME efficiency indicators are based on an SME experience where an ERP system was applied. The algorithm that enables the SME and ERP to be combined was defined as the GMDH (Group Method of Data Handling), and it involves the following assumptions [3]: a precise description of the interdependence between the output and input data (selected SME efficiency indicators with the characteristics of a given ERP system as well as the characteristic of the company in which the system was implemented), and a minimum modeling error. As a result of GMDH algorithm implementation, the best possible polynomial was obtained which was characterized by the lowest value of the criteria of regularity assigned to the object – the pair: ERP and an SME (respectively the SME and the *SAP Business One* system or *Comarch CDN XL*. The algorithm evolution process was completed at the second iteration. It is worth pointing out that the second degree of the polynomial was obtained as a result of the implementation of the SME and effective operation indicators database with ERP system parameters for *SAP Business One* and *Comarch CDN XL*. Thus, it can be different from the new ERP database for effective operation indicators.

(5) What kind of decision supporting structure should be used in relation to the ERP system purchase, being at the same time the implementation of the ERP method?

The decision model is contracted on the basis of the knowledge database. It includes complex information about all processes which could be observed while the database was being created, so examples of both successful and unsuccessful ERP system implementations are included. The application of empirical knowledge enabled the application of the GMDH as a modeling tool. In conclusion, the decision model which was under examination binds the selected indicators of the effectiveness of SME implementation with the parameters of a given ERP system and the parameters of the company which introduced this system. This restriction makes the decision making process simple and brings it to some kind of restriction propagation pattern (chosen decision making indicators of implementation for the ERP system under examination). It means that, for some companies, the assessment of the effects which ERP would bring can be done on the basis of previously defined indicators and the experience of those companies which have already applied an ERP integrated information system.

In accordance with the data included in the SME functionality indicators database, including ERP parameters, all variations of GMDH algorithms [3] were investigated using the computer software *Consulting IT system for the ERP implementation effects in small and medium size companies.*

4. MODEL OF ERP SELECTION FOR THE SME

The main problem in responding to the question whether a given ERP system will guarantee us obtaining the assumed level of an SME performance index for the assumed costs and existing limitations or not is presented as a decision problem. In order to illustrate the possibility of answering the question, let us analyze whether there exists an ERP system that would allow an SME to reach the intended objectives assessed using arbitrarily chosen SME effectiveness indicators.

In accordance with the values of the selected SME efficiency indicators and ERP system parameters, there was constructed a decision model which contains: the Group Method of Data Handling, which bounds the selected indicators of SME effectiveness with ERP parameters (characteristics) along with the company parameters, and an SME experience where an ERP system was applied (the parameters of ERP systems (*SAP Business One* or *Comarch CDN XL*) and the values of the selected indicators of SME efficiency).

The elements in the decision model (ERP parameters, selected SME functionality indicators values) were obtained as a result of research carried out in the area of the Lubuskie region, Poland, during the time period between January and September 2005. The data were collected in companies operating within the SME sector where an ERP system was applied, and the companies belonged to the reference model of the SME [6].

This decision model will provide effects if the following assumptions are made:

- A company is a static object with enough approximation company class definition (only then is the advanced group method of data handling applicable).
- The output parameters values (SME parameters, ERP systems parameters, the values of SME efficiency indicators) do not change critically within a period of time.
- The decision model makes a good mathematical model of the object [3].

In accordance with the data included in the ESP efficient operating indicators database, including ERP parameters, all variations of GMDH algorithms [3] were investigated using the computer software *Consulting IT system for the ERP implementation effects in small and medium size companies.*

As a result of algorithm implementation, the best possible polynomial was obtained which was characterized by the lowest value of the criteria for regularity assigned to the object (respectively the SME and the *SAP Business One* system or *Comarch CDN XL*). The algorithm evolution process was completed at the second iteration. It is worth pointing out that the second degree of the polynomial was obtained as a result of the implementation of the SME and effective operation indicators database with ERP system parameters for *SAP Business One* and *Comarch CDN XL*. Thus, it can be different from the new ERP database for effective operation indicators.

In this way, obtaining the smallest modeling error, the polynomial version was selected, which is shown in the Fig. 4 and Fig. 5.

Consequently, the best possible polynomial in relation to the SAP Business One is shown in Fig.4.

$$W(W_1 W_2) = 0{,}00018\, W_1 + 0{,}10585\, W_2 - 0{,}00040\, W_2^2,$$

where:

W_1 - labor efficiency indicator (after tax sale / number of employees),

W_2 - labor profitability indicator (after tax profit / labor costs).

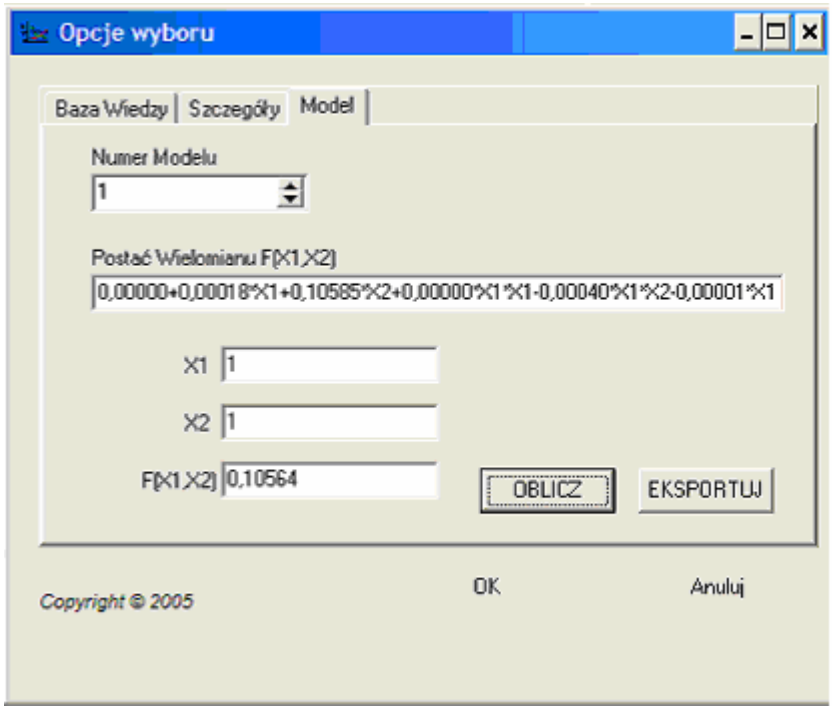

Fig. 4. The best possible polynomial in relation to the SAP Business One

So, the best possible polynomial in relation to the Comarch CDN XL is shown in Fig. 5.

$$W\ (W_1\ W_2) = W_2,$$

where:
W_1 - labor efficiency indicator (after tax sale / number of employees),
W_2 - labor profitability indicator (after tax profit / labor costs).

In conclusion, the decision model for ERP efficiency implementation (using the original software *Consulting IT system for the ERP implementation effects in small and medium size companies)* under examination binds the selected indicators of the effectiveness of SME implementation with the parameters of a given ERP system and the parameters of the company which introduced this system. This restriction makes the decision making process simple and brings it to some kind of restriction propagation pattern (chosen decision making indicators of implementation for the ERP system under examination).

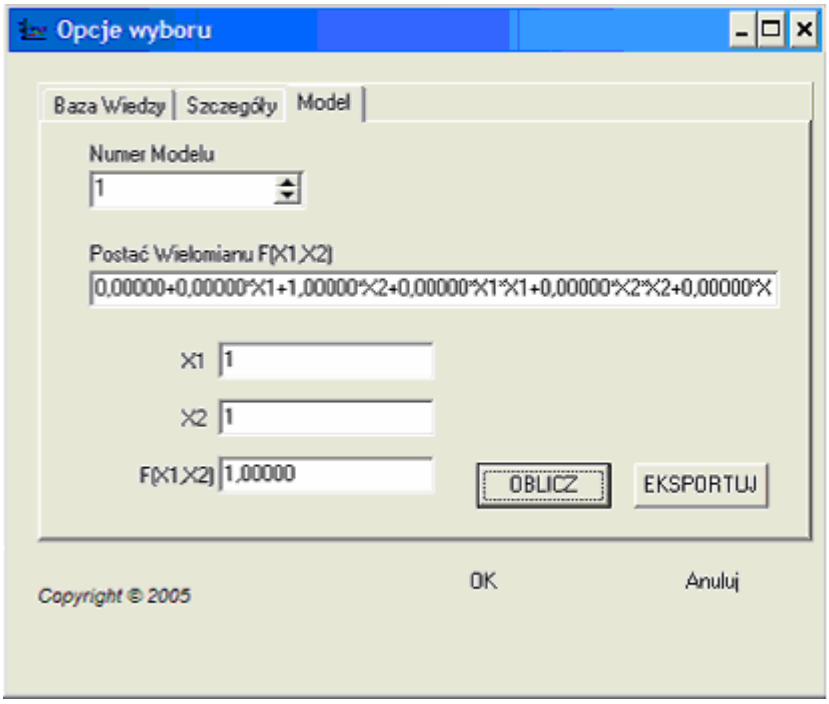

Fig. 5. The best possible polynomial in relation to the Comarch CDN XL

The main problem that involves the decision making process, which is understood as a problem of such an ERP system selection that would guarantee the improvement of the indices previously determined by the user, involves ERP implementation with a research method that would define the efficiency of a given implementation. The selected measures enable us to proceed with the monitoring of a group of companies that are similar in relation to the user's demands, and also gives way to the development of an ERP group system which would meet the given demands.

It means that, for some companies, the assessment of the effects which ERP would bring can be done on the basis of previously defined indicators and the experience of those companies which have already applied an ERP integrated information system.

4.1. Prediction value for the defined indicators in SMEs

The stage of the ERP system variations and prediction testing of certain SME functionality indicators allows introducing conclusions concerning the ways in which the prediction is proceeded using the EWE implementation method.

The decision model which has been defined enables us to carry out a re-assessment of ERP implementation. Precisely defined indicators are ascribed to this model, which allows us to define the potential values of these parameters after the system has been implemented. So, on the basis of the data, a function which normalizes the indicators assigned to the decision making model is introduced. The forecast value of the selected SME efficiency indicators is

shown in Fig. 6. (using the original software *Consulting IT system for the ERP implementation effects in small and medium size companies*)

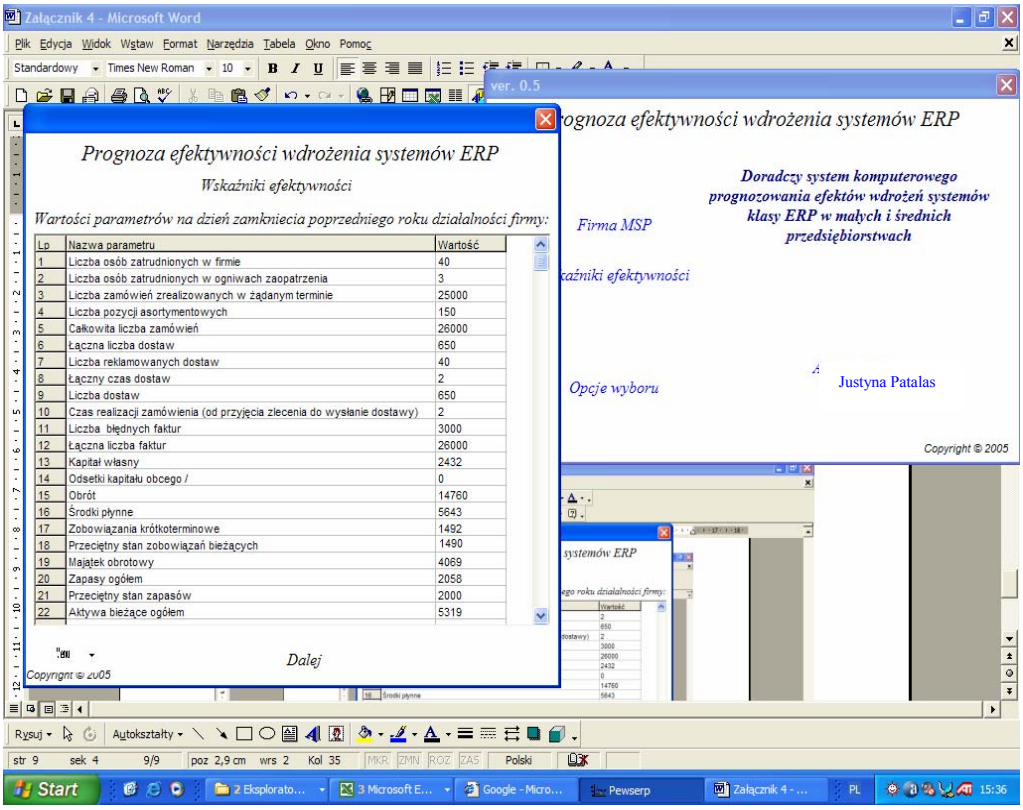

Fig. 6. The parameters of SME

Fig. 7. The company, that is about to make decision concerning the introduction of ERP system

Lp.	turn over profitability	labor profitability indicator	involved capital indicator	the company functionality the supply	labor efficiency indicator	storage rotation indicator II
1.	0,9	0,06405694	1566	1	14,05	35,43
2.	0,732612	0,054911031	1442,8	1	13,3417942	36,49
3.	0,717739	0,06126908	1841,9	1	11,71453964	42,07
4.	0,754271	0,059571449	1909,1	1	12,66162257	42,98
5.	0,686459	0,056675363	2433,1	1	12,11213048	43,06
6.	0,633298	0,052419765	2577,8	1	12,08128018	50,91

So, the best possible polynomial (decision model) in relation to the Comarch CDN XL binding the selected indicators like: W1 - *turn over profitability indicator*, W2 - *work profitability indicator* (using the author's software *Consulting IT system for the ERP implementation effects in small and medium size companies)* is defined:

$$W (W1, W2) = W2,$$

where:
W1 = turn over profitability indicator, W2 - labor profitability indicator

This model is a synthetic indicator of effectiveness that consist of certain particle indicators (in indicators database: W1- 30, W2-47) is the polynomial Nr. 10, with criteria value r = 0,0353 (Fig. 8.)

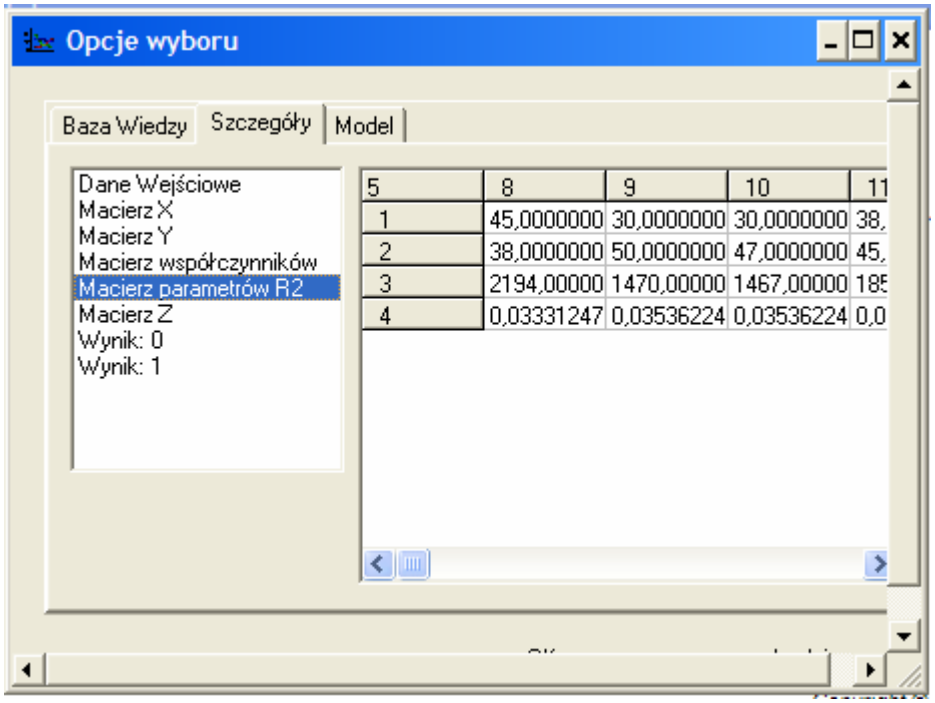

Fig. 8. The best possible polynomial (decision model) in relation to the Comarch CDN XL binding the selected indicators like W1 = turn over profitability indicator, W2 = labor profitability indicator

The value prediction of the such defined polynomial (decision model) in relation to the Comarch CDN XL is constants value and is such the present labor profitability indicator value (in accordance with the defined decision model).

$$W = 2{,}6545+12{,}7608W2-0{,}2415\ W2^2- 235198003$$

where:
W1 = involved capital indicator,
W2 = the company functionality – the supply.

This model is a synthetic indicator of effectiveness that consist of certain particle indicators (in indicators database: W1 - 33, W2-14) is the polynomial Nr. 198, with criteria value r = 0,6756 (Fig. 9.)

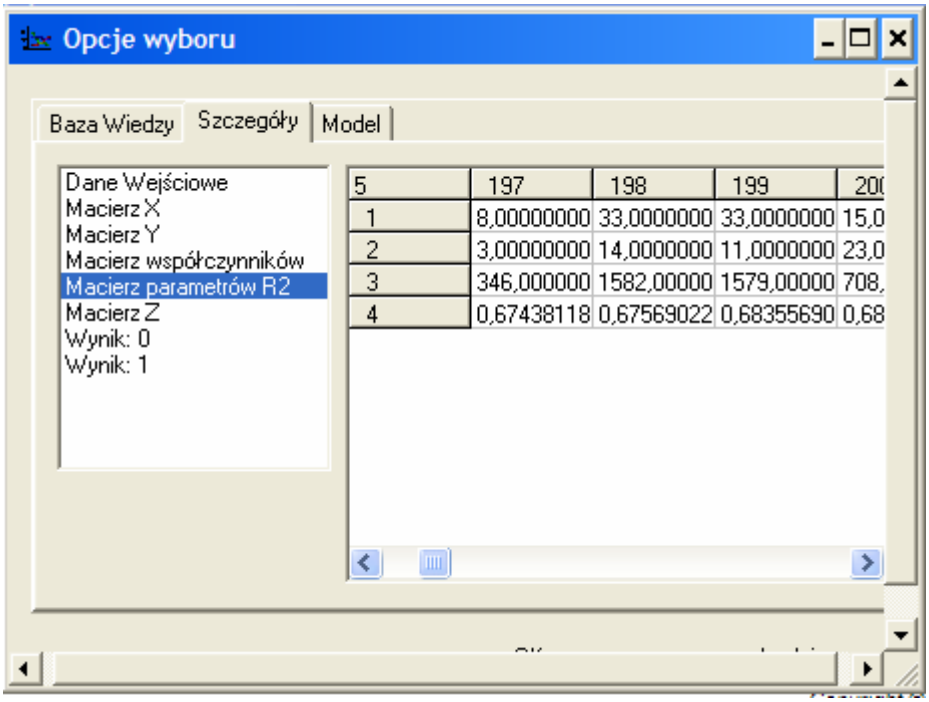

Fig. 9. The best possible polynomial (decision model) in relation to the Comarch CDN XL binding the selected indicators like W1 = involved capital indicator, W2 = the company functionality – the supply

The value prediction of the defined indicators W1 = involved capital indicator, in relation to the Comarch CDN XL is depended on W2 = the company functionality – the supply, also for the enterprises, which included such company functionality is constants and W(W1,W2) = - 2335,83 (in accordance with the defined decision model):

Consequently, in order to illustrate the comparison both decision models in relation to the Comarch CDN XL and SAP Business One let us consider a decision model in relation to the SAP Business One binding the selected indicators like W1, W2.

The best possible polynomial (decision model) in relation to the SAP Business One binding the selected indicators like: W1 = storage rotation indicator II, W2 = labor profitability indicator:

$$W(W1, W2) = -0{,}002W1+0{,}1117W2+0{,}1001W2^2+0{,}0026W1W2$$

where:
W1 = storage rotation indicator II,
W2 = labor efficiency indicator.

This model is a synthetic indicator of effectiveness that consist of certain particle indicators (in indicators database: W1- 40, W2-47) is the polynomial Nr. 88, with criteria value r = 0,5286 (Fig. 10.)

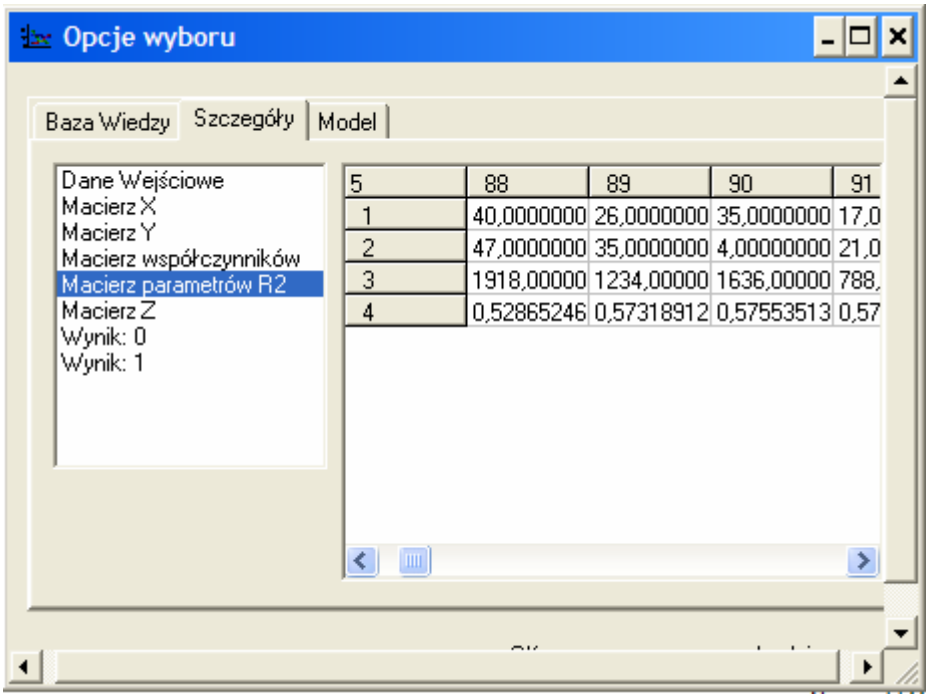

Fig. 10. The best possible polynomial (decision model) in relation to the SAP Business One binding the selected indicators like W1 = storage rotation indicator II, W2 = labor profitability indicator

$$W(W1, W2) = 0{,}0091W2$$

where:

W1 = involved capital indicator**,**
W2 = labor productivity indicator.

This model is a synthetic indicator of effectiveness that consist of certain particle indicators (in indicators database: W1- 33, W2-46) is the polynomial Nr. 12, with criteria value r = 0,0103 (Fig. 11.)

Consequently, in accordance with the defined decision model the value prediction of the defined indicators is constants and is such the present value of labor productivity indicator.

It is worth pointing out that in accordance to the database all the variants were investigated and the procedures accessible in the computer software *Consulting IT system for the ERP implementation effects in small and medium size companies,* which links pre defined indicators of the ERP implementation efficacy. In this way the smallest modeling error was obtained , and at the same time, connecting given indicators, which was described as decision

models - polynomial. The selection that was made confirms the assumption that for different ERP systems which even connects similar efficacy indicators for the ERP implementations the decision model can be different. It is understandable, taking into consideration that they were developed in accordance with different operating efficacy database and ERP system parameters.

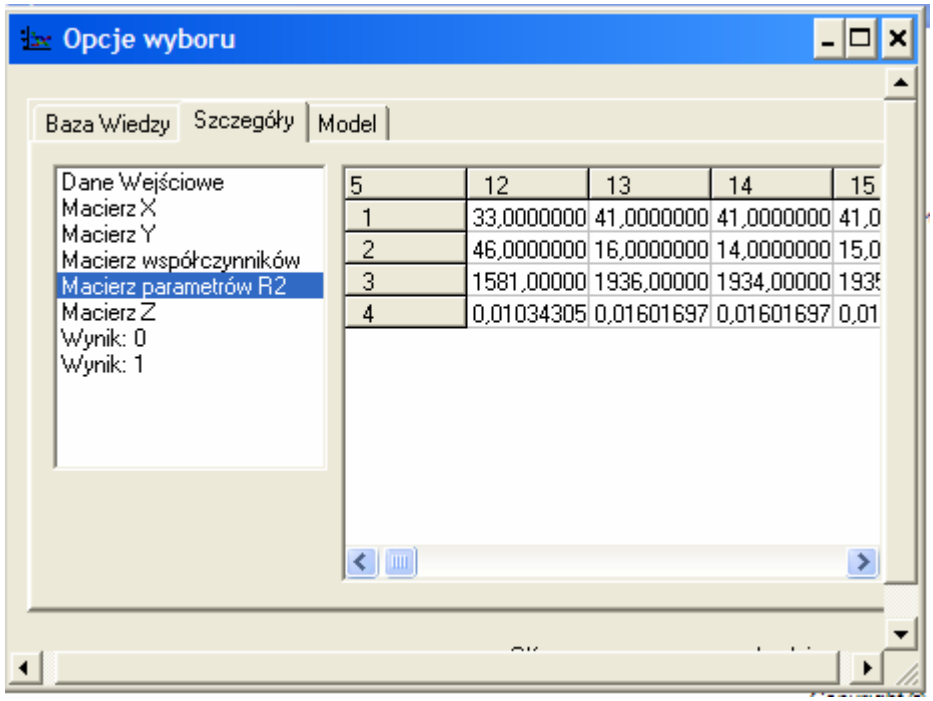

Fig. 11. The best possible polynomial (decision model) in relation to the SAP Business One binding the selected indicators like W1 = capital involved indicator, W2 = labor productivity indicator

So, on the basis of the decision making model a forecast of a defined indicators value is introduced to the company . As a result, the company must make a decision as far as the purchase of the ERP system is concerned. This system is defined as Sap Bussines One, Comarch CDN XL, based on value forecasting.

It is worth comparing the all model binding the selected indicators in relation to the SAP Business One and Comarch CDN XL. The defined models are different, because they binding the different ERP parameters and the selected functionality indicators. The indicators, they binding two models, are: labor profitability indicator and capital involved indicator.

It is worth pointing out that in accordance with the database all variants were investigated and the procedure was implemented using the computer software *Consulting IT system for the ERP implementation effects in small and medium size companies,* which links the pre-defined indicators of ERP implementation efficacy. In this way the smallest modeling error was obtained and, as a result, polynomial models were selected. The selection that was made confirms the assumption that for different ERP systems, which even connect similar efficacy indicators for ERP implementations, the decision model can be different. This is

understandable, taking into consideration the fact that they were developed in accordance with different operating efficacy databases and ERP system parameters.

4.2. Model of ERP selection for SMEs

The ERP implementation efficiency method which has been suggested enables us to build a decision model which involves all elements of the method structure for ERP in SME (EWE) implementation efficiency. The modeling object consists of the pair: an ERP system and an SME, which is described as a numerical set of the values of selected indicators of SME operation functionality, ERP characteristics and the parameters of the company that implemented the system. The procedure will be developed for ERP system variations in small and medium size companies. The ERP purchase decision support system will be based on an empirical database, being the implementation of the EWE method, and would include the values of the defined efficiency indicators after and before ERP implementation as well as the GMDH algorithm. The solution defined as an obtainable ERP implementation efficiency indicators prediction will be shown with the assistance of the consulting IT software. Consequently, a recommended ERP system for an SME will be shown.

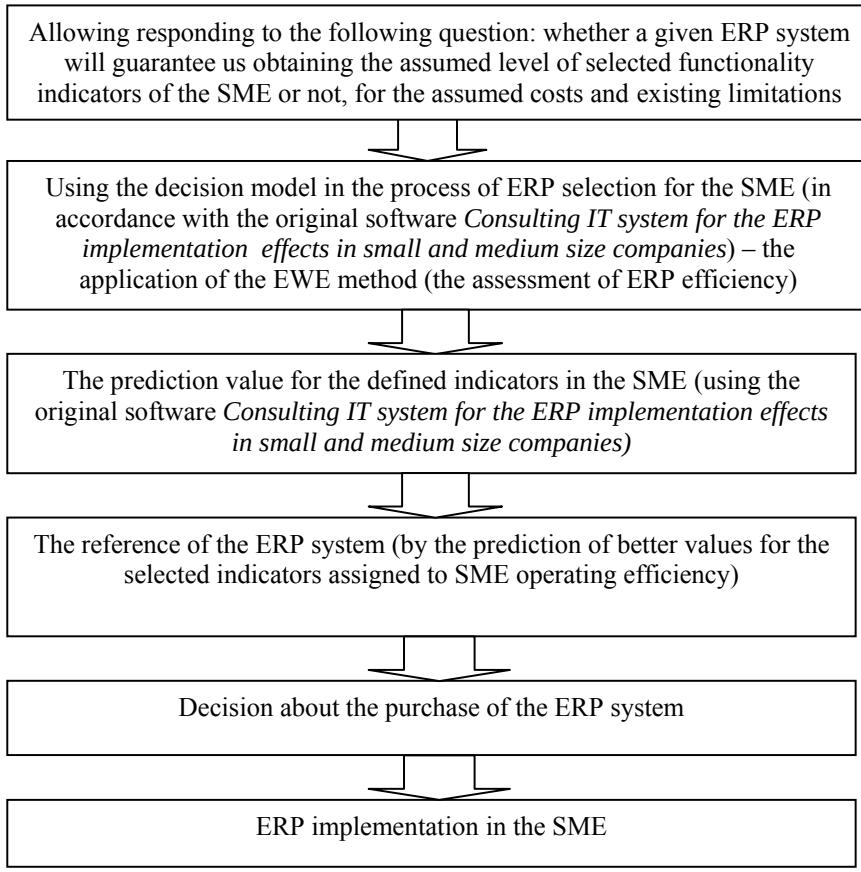

Fig. 12. Model of ERP selection for SMEs

The ERP selection model in the SME which has been defined enables us to carry out an assessment of ERP implementation. The precisely defined indicators are ascribed to the decision model, which allows us to define the potential values of these parameters after the system has been implemented. In accordance with the company database, the decision model is presented to the company in the form of value prediction of the defined indicators (W1 or W2), which was obtained after ERP implementation. As a result, on the basis of the obtainable prediction values, it was recommended to the company to use the ERP system, which was conditioned by the prediction of better values for the selected indicators assigned to SME operating efficiency.

5. CONCLUDING REMARKS

An original method for ERP in SME (EWE) implementation efficiency assessment has been developed. It consists of 5 elements, that is: (1) ERP system parameters, (2) SME company parameters, (3) an SME experience which proceeded the ERP project, (4) functionality indicators values, (5) an algorithm that enables ERP and SME characteristics binding – a GMDH algorithm, The application of the EWE method allows predicting economical effects as far as the implementation of ERP is concerned, taking into consideration efficiency indicators in the analyzed company.

The method proposed just shows a concept associated with the assessment of ERP in order to find its effective SME implementation. The concept which has just been introduced draws upon the experience of the companies which introduced the system. The use of empirical knowledge enabled the application of Iwachnienko's algorithm as a modeling tool. It made the automatic synthesis possible, which is characterized by high accuracy of estimation. It is essential to point out that this concept does not require any result interpretation because the decision model includes this mechanism. It is also important that it allows carrying out objective system effectiveness assessment.

On the basis of the EWE method, a decision model for ERP efficiency implementation has been developed. The decision model is contracted on the basis of the knowledge database. It includes complex information about all processes which could be observed while the database was being created, so examples of both successful and unsuccessful ERP system implementations are included. Thus, on the basis of the decision making model, a forecast of the values of selected indicators is introduced to the company. As a result, the company must make a decision as far as the purchase of the ERP system is concerned. This system is defined as *Sap Bussines One, Comarch CDN XL*, based on value forecasting.

It was concluded that on the basis of the decision model, the company of the SME sector will obtain the prediction of the defined SME functionality indicators after and before ERP implementation, defined as *SAP Business One* and *Comarch CDN XL*.

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