A Support System for Developing E-Business Strategies

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Abstract

The idea of a modular toolkit is presented that can help to manage the complex task of e-Business strategy formulation. It provides a flexible architecture to integrate different software tools and it ensures a structured approach in the strategy development process. Two tools have already been developed: an e-Business index to assess e-Readiness and a tool supporting e-Business investment decisions. The former is intended to allow a company-wide, fully integrated view on e-Readiness according to Porter's value chain. The latter is based on fuzzy technology in order to take into account that only few factors influencing e-Business investment decisions can be measured monetarily.

1. Problem

The rapid diffusion of information and communication technologies and applications based on the Internet have led to a transformation of markets, products, and companies. The resulting new processes and structures, often referred to as e-Business, increase efficiency by applying innovative interaction and coordination patterns - "e" as an enabler. In addition, new strategic options have come up, since information and communication technologies have opened up unexploited potential for innovative products and services - "e-Change" (see Fig. 1).

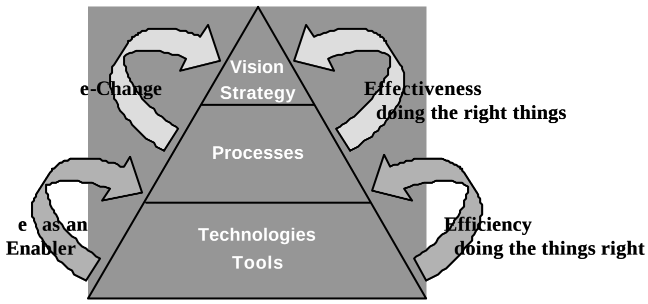

Fig. 1 e-Business pyramid

Approaches to increase efficiency are widely spread. Especially methods to optimize business processes are commonly accepted. Reference processes and design rules as well as numerous IT-based tools to optimize and to execute business processes are available.

In contrast, IT-based methodological support for the development of eBusiness strategies has not been introduced to a satisfactory extent. Consequently, software tools that help to handle this task are not yet available (Wegener 2001). A newly published approach by alfabet meta-modeling AG (alfabet 2002) depicts some requirements that need to be met.

In this paper we present the concept of a modular toolkit to support the development of e-Business strategies: the e-Strategy-Explorer. Our research focuses on two major aspects: identifying the key issues and tasks in the process of e-Business strategy formulation and using the results to design and realize appropriate software tools that can assist the strategist in performing his tasks.

In Section 2 the support of strategy formulation in e-Business projects by software tools is motivated. Section 3 provides an overview of the system architecture. Two prototypes of software tools are illustrated in section 4.

2. E-Business Strategy

In order to successfully participate in e-Business, a sound and viable strategy is of major importance since e-Business touches numerous strategic areas like sales policy, customer relationship management (CRM), or logistics strategy (e.g. electronic supply chain management – e-SCM). Prior to the emergence of the Internet, strategic information systems planning was a subset of corporate strategy. Its main focus was to align information technology resources with wider business goals (Courtache 2002). In the networked economy, the role of information technology changed from supporting business processes (enabling function) to defining new business models (initializing function).

Disappearing technological restrictions and especially the flexibility of the Internet led to a renaissance of strategic planning. Exploring the actual needs of the customers, questioning the assumptions of markets or industries are still the essential elements of any strategic planning process. Many traditional strategic principles and objects like customer segmentation, cost situation, or market positioning have not become obsolete (Evans 2000).

With e-Business, the dynamics of economic life has increased fundamentally. E-Strategies fail in reality because they are rapidly outdated. Competitive advantages erode faster than they can be defended. The short history of 'doing business electronically' and the resulting lack of experience might be one possible explanation. But since investments in e-Business activities and infrastructure have evolved to a major cost factor, a methodologically well-founded approach to e-Business strategy development is claimed by practitioners as well as scientists.

Strategic Management is a very information intensive process. Quantitative and qualitative data have to be collected and implicit knowledge has to be made explicitly available. The growing potential of information technology to facilitate managing intellectual assets can help to carry out these processes (Hansen 1999). But software is not only capable of managing the flow of information, it can also support the strategy process itself by providing appropriate tools to execute certain strategic tasks IT based. This insight led to the idea of the e-Strategy-Explorer which is drafted in the next sections.

3. System architecture

The system architecture consists of four layers that are illustrated in Fig. 2.

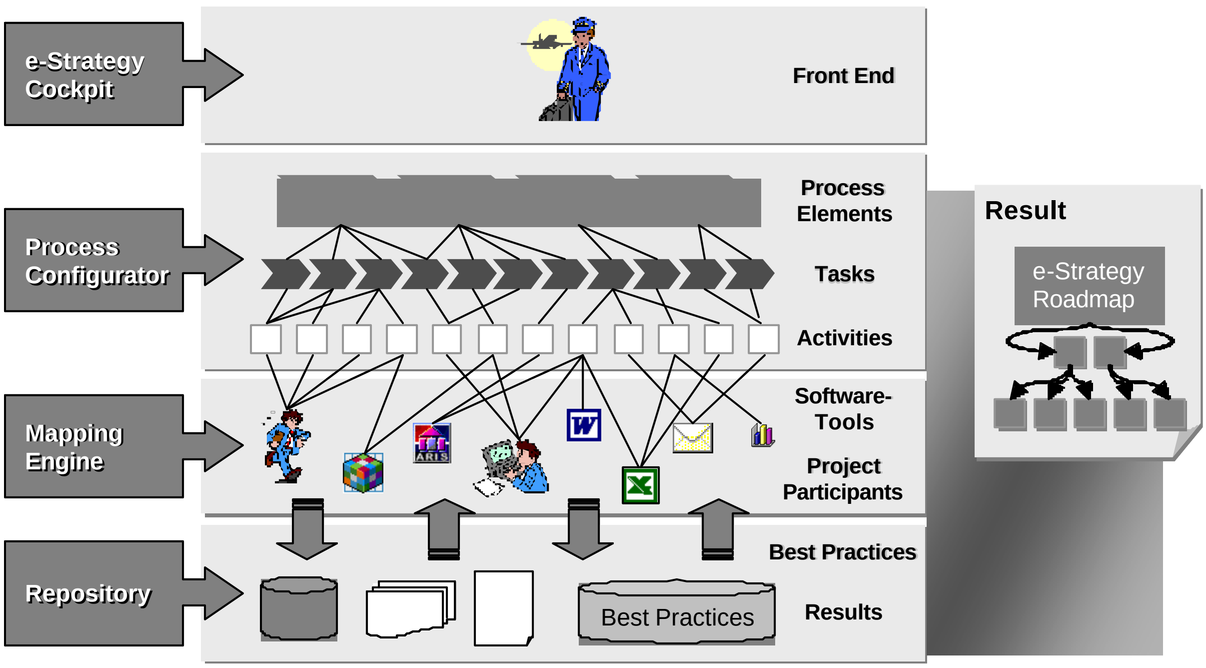

Fig. 2 System architecture

e-Strategy-Cockpit

This layer represents the front end of the e-Strategy-Explorer for user interaction. It will be implemented as a Web-based application to provide an easy to use access to the strategy development process.

The e-Strategy Cockpit controls all other application layers. Key functions include the selection of required methods and the software tools needed in the strategy process, navigation and search mechanisms to retrieve relevant information stored in the repository and the visualization of a projects´ progress.

Process Configurator

The Process Generator is the core component of the e-Strategy-Explorer. It is based on a method that has proven its capabilities in numerous projects. The strategy exploration process is broken down into process elements, tasks and activities. Process elements represent the main stages of strategy development (preparing, scouting, guiding, and implementing). In each stage, certain tasks need to be performed, e.g. a SWOT-analysis or a return on investment evaluation. Tasks are further divided into activities. Activities characterize the smallest entities of this architecture and are performed by members of the project team. Fig. 3 provides an example. The task “customer assessment” within the scouting phase may include the activities “segmentation workshop” and “customer interviews”. The segmentation workshop could be supported by special presentation templates or structured spreadsheets. A conceivable result type is an ABC-analysis portfolio. Customer interviews can be carried out online and automatically processed into a customer satisfaction index.

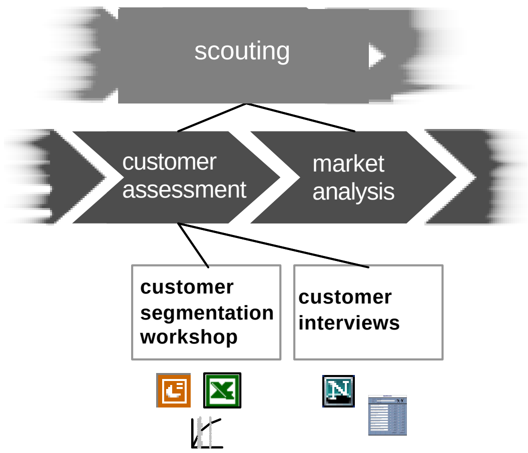

Fig. 3 Strategy process

This hierarchically structured approach was chosen because it offers flexibility. The Process Configurator can be customized according to specific requirements and complexity of different e-Business strategy projects because tasks can be assigned to multiple process elements and activities can be assigned to multiple tasks. For example, for one project it might be sufficient to estimate market development with simple reference indices whereas another project requires comprehensive competition and market analysis. The concept ensures a maximum of transparency over the process of strategy design and the details of decision making can be exactly retraced even long time after the completion of a project. Moreover, it seems likely that the drill-down approach for strategy development improves the quality of output in different stages of the project, since different project participants are forced to use the same methodology and tools.

Mapping Engine

The Mapping Engine sets the link between the Process Configurator and the software tools. Pre-defined activities are executed by activity owners with the help of computer-aided tools. The selection may include simple word processors, sophisticated systems for Computer Supported Co-operative Work (CSCW), or Business Process Reengineering (BPR) software.

An important goal of the project is the development of a toolbox based on standard software. It will consist of a variety of tools ranging from static checklists for the preparation of an e-strategy workshop to dynamic templates for presentation and documentation as well as small programs that support cost-benefit- or ROI-analysis. Two tools have already been developed and are presented in Section 4.

Repository

Results of a strategy development process are stored in a repository database. This offers the possibility to evaluate completed projects and the respective e-strategies against results from other projects. Successful activities and external sources (e.g. scientific publications) are collected in a best practice database. The repository does not only ensure that strategic premises are still available on an operational level but can also help to improve the whole system (learning system).

It is important to point out that the system is not intended and capable to replace traditional software used in strategy projects like project management tools. The idea of the toolkit is to provide a coordination and workflow platform that guides the user through the complex stages of an e-Business strategy project and compels him to use a structured approach. It suggests appropriate software tools in order to perform his tasks more efficiently and to guarantee result types that have proved their capabilities.

4. First Results

4.1. e-Business Index

(1) Background

A very important element in the process of developing an e-Business strategy is a thorough self diagnosis. Current strengths and weaknesses have to be analyzed, not only to improve existing e-Business activities but also to identify new opportunities.

A lot of indices have been developed to measure "e-Readiness". Some of them are accessible online, for example Cisco's "Net Readiness Scorecard". A shortcoming of many approaches is that they concentrate on certain aspects (e.g. the design of Web-sites or the existence of customer relationship management software) but do not provide a comprehensive analysis of all functional areas.

In the following sections a prototype tool is outlined that helps evaluate the level of e-Readiness in terms of an electronic questionnaire.

(2) Requirements

The e-Business index was developed in cooperation with experienced management consultants. The following basic requirements had been defined:

1. Comprehensive approach:
   The index has to cover all functional and non-functional areas of a company and the business network it is operating in.
2. High level of detail:
   The index has to deliver detailed and transparent results for all analyzed objects to ensure the quality of results and to facilitate interpretation.
3. Scalability: New technologies can have impact on e-Business related opportunities. The index has to offer the possibility that new variables can be included.

(3) Selection of Indicators

To verify the current situation of a company and to identify further potential, appropriate indicators have to be defined. Hartmann (Hartmann 2000) proposes four categories that are essential to determine the level of e-Business readiness: technology, organization, leadership, and capability. Technology related indicators cover the hardware and software architecture as well as standards that ensure the efficient use of technology. Indicators concerning organizational issues do not only cover the structure but also the decision process or responsibilities in e-Business projects or relationships to external partners. The consistency of strategies on corporate and business unit level and the e-Business commitment of the top management is subject of the category leadership. Capability comprises qualifications of employees as well as the available know-how on a corporate level, e.g. the efficiency of product development processes.

The parameter value of an indicator is influenced by many aspects that are represented by a set of questions related to it. Answers to questions are coded into values. Answer values can range from "0" to a maximum number that corresponds to the overall quantity of alternatives. The higher an answer value the more favorable the answer is considered regarding e-Readiness. If the question allows the user to choose multiple answers, values of individual answers are added up.

(4) Structure

The index is constructed hierarchically. It consists of four different levels that correspond to different stages of aggregation (see Fig. 4). The top level 0 represents the e-Business index for the whole company. Level 1 relates to different processes. To meet the requirement of a comprehensive approach, Porter's value chain framework is used to ensure that all primary and supporting activities are taken into account (high level of detail). Modules offer the possibility to group a specific set of questions. The activity "inbound logistics" may consist of the modules "material handling" and "warehousing". This does not only enhance transparency of the questionnaire but it also provides the possibility to skip certain question blocks if they are considered not important. Questions related to marketing activities could be categorized according to the elements of the marketing mix (product, price, etc.). It is also possible to assign the module product to the process research and development. Moreover, this architecture allows for the calculation of intra-modular and inter-modular sub-indices, e.g. for the areas of Marketing or Controlling.

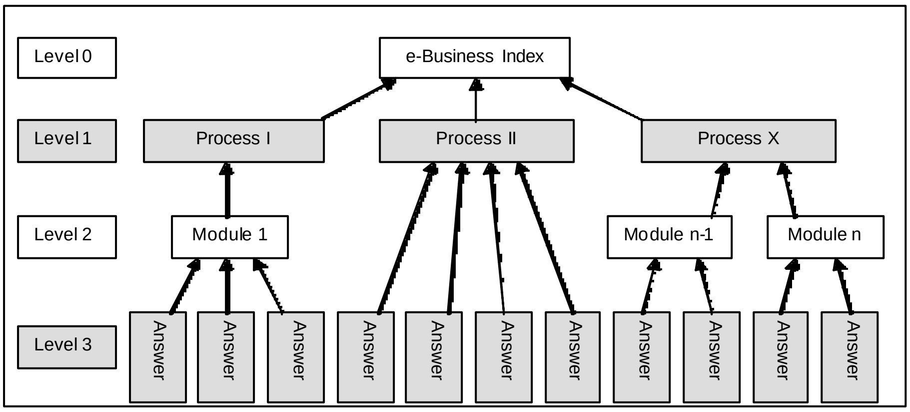

Fig. 4 Structure of the e-Business index

(5) Calculation and Output

The first step in calculating the index is to summarize the answer values of a particular interview. It is possible to define weighting factors to modify the degree of influence of specific variables on the index (see eq. 1). For example, the number of printers may be interesting for statistical purposes but does not have a significant impact on e-Business activities.

$$SA = \sum_{i=1}^{n} a(i) \cdot w(i) \qquad (1)$$

SA = sum of answer values; a = answer value; w = weighting factor; i = number of question

In the next step, the sum of maximum answer values is being calculated (see eq. 2). It has to be emphasized that the same weighting factors need to be used in both equations to get correct results.

$$SA_{max} = \sum_{i=1}^{n} a_{max}(i) \cdot w(i) \qquad (2)$$

SA_{max} = sum of maximum answer values; a = maximum answer value; w = weighting factor; i = number of question

The result of equation 1 (status quo of e-Readiness) divided by the result of equation 2 (maximum possible e-Readiness) multiplied by 100 yields a percentage value for each interview.

A score for each module or process is obtained by calculating the average of all interviews. Module and process scores are consolidated without using additional weighting factors. For example, a score of 65% for module 1 and 80% for module 2 yields to a score (54+80)/2 = 72,5% for the superordinated process.

(6) Implementation

A prototype was developed using Microsoft Access and Visual Basic for Applications. All questions are stored in a database. So, existing topics can be modified or new questions can be included easily. Fig. 5 shows an example of an electronic question form.

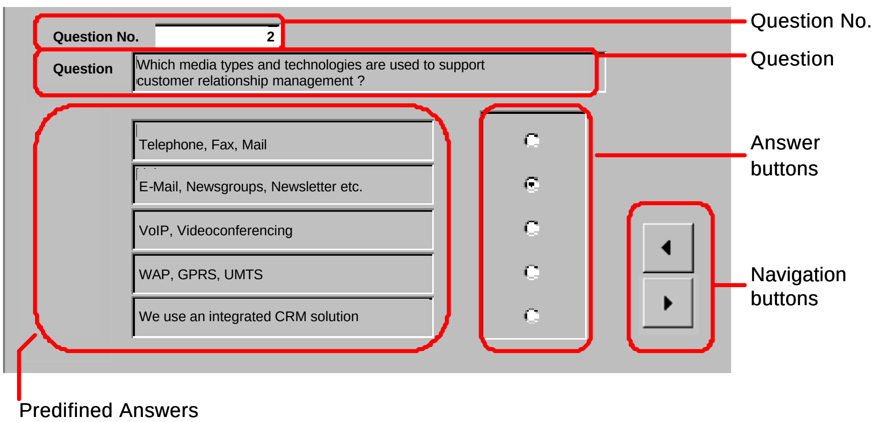

Fig. 5 electronic question form

As previously mentioned, it is possible to calculate sub-indices for different categories (e.g. modules). The tool provides different options for visualization. Fig. 6 shows an example where four indices are displayed in one graph.

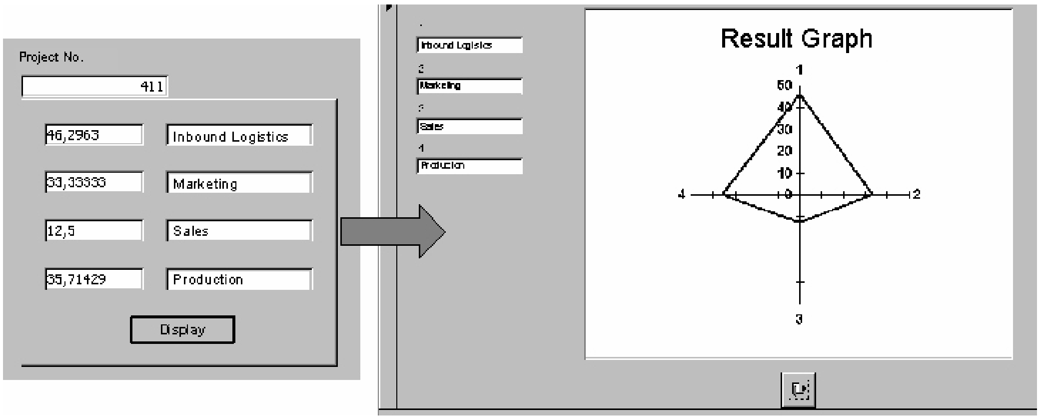

Fig. 6 Visualization of results

4.2. Assessment of e-Business applications using fuzzy logic

(1) Background

Investments in e-business infrastructure face high expectations regarding their contribution to future company success. In this field, the monetary profitability is often less important than its strategic importance. The term “e-business application (EBA)” refers to all information systems supporting internal and external business processes.

Due to the complex effects on markets and business processes and high uncertainty prevailing in the e-Business sector, traditional investment decision methods are hardly sufficient for deciding over investments in e-Business applications. In the following sections n approach is introduced that uses fuzzy logic to deal with the peculiarities of investments in the field of e-Business. It integrates monetary profitability, non-monetary aspects, and the risk of the EBA investment. The concept is also used as an underlying framework for the development of a software prototype.

(2) Fuzzy logic concept

Traditional methods estimate the costs and benefits of EBA by assigning discrete parameter values. If fuzzy numbers are introduced, ranges in which the actual values are expected are used instead of these sharp values. The closer to the boundaries of this area a value is, the less likely its realization is considered.

If the influencing factors are represented by fuzzy numbers, the output variable can be calculated by means of special fuzzy operators. The output variable itself is a fuzzy number as well. The decision’s risk is embodied by the fuzziness of the output variable since it is derived from the membership functions of the input fuzzy numbers. The processing of fuzzy numbers follows Zadeh’s extension principle (Zadeh 1975). To simplify the calculations, the inverse functions of the membership functions can be used.

We chose three different indicators that are frequently used for the preparation of an investment decision: net present value (NPV), return on investment (ROI) and value benefit analysis (VBA). The first two are based on monetary criteria whereas the latter evaluates primarily non-monetary costs and benefits.

Net present value

The net present value (NPV) analysis assumes the goal of capital maximization. The basic concept is the interpretation of investment projects as a number of payments and the discounting of these payments to permit comparison (Daeumler 2000). The NPV is an absolute criterion of profitability, i.e. the investment in a single project can be judged independent from other projects. The fuzzy net present value is a fuzzy number, whose value at the membership degree $\mu=1$ represents the sharp NPV. The membership function yet defines a range of uncertainty in which the actual value may vary.

Aside of receipts and expenditures a discount rate has to be selected, which can be considered the minimum return subjectively claimed by the investor from any investment (Daeumler 2000). The NPV analysis in its basic form uses a single interest rate, i.e. it does not differentiate between debit and credit rates.

The sharp net present value is defined as (Jenssen 1997):

$$NPV = \sum_{t=0}^{T} \left(R_t - E_t\right) \cdot (q)^{-t} \ ; NPV, R_t, E_t, q \in \mathbb{R} \tag{3}$$

T: expected lifetime of the investment (number of periods); R_t: Receipts in period t; E_t: Expenditures in period t; q = 1 + r with r: interest rate

To calculate the fuzzy NPV, the input values and the NPV itself are defined as invertible fuzzy numbers:

$$NPV, R_t, E_t, q \in \mathbb{F}$$

They also can be described by their inverse functions as defined above:

$$U = (U'; U''); U \in \mathbb{F}$$

Since the term ($R_t - E_t$) can become negative and in this case would no longer conform the requirement of being strictly positive, the NPV equation has to be modified for the fuzzy NPV:

$$NPV = \sum_{t=0}^{T} R_t \cdot \left(\frac{1}{q}\right)^t - \sum_{t=0}^{T} E_t \cdot \left(\frac{1}{q}\right)^t ; NPV, R_t, E_t, q \in \mathbb{F} \tag{4}$$

Using equation 4, only one subtraction is necessary. By using the notation of upper and lower inverse functions the fuzzy NPV is defined as follows:

$$\left(NPV'; NPV''\right) = \sum_{t=0}^{T} \left(R'_t; R''_t\right) \cdot \left(\frac{1}{q''}; \frac{1}{q'}\right)^t - \sum_{t=0}^{T} \left(E'_t; E''_t\right) \cdot \left(\frac{1}{q''}; \frac{1}{q'}\right)^t \tag{5}$$

Return on investment

The return on investment (ROI) is a profitability ratio calculated from profit and the employed capital. There are various ROI definitions using alternative profit concepts and profitability ratios. In the concept described the capital profit (return less expense without consideration of capital cost) is used as numerator. The result is a gross ROI which equals the return on total investment and is independent from the way of financing.

In ROI analysis an overall ROI for whole lifetime of an investment as well as a ROI for each period can be determined. This allows analyzing developments over time. The ROI of a period t (ROI_t) is defined as the ratio of the period's profit and its average fixed capital (AFC_t). The profit is the difference between revenues and costs (current costs and allowance for depreciation, $C_t = {}_{curr}C_t + {}_{AD}C_t$):

$$ROI_t = \frac{RE_t - C_t}{AFC_t} \quad ; \quad ROI_t, RE_t, C_t, AFC_t \in \mathbb{R}. \tag{6}$$

The variables are defined as invertible fuzzy numbers:

$$ROI_t, RE_t, C_t, {}_{curr}C_t, {}_{AD}C_t, AFC_t \in \mathbb{F}$$

In the notation introduced above for invertible fuzzy numbers the ROI_t can be expressed as follows:

$$\left(ROI'_t; ROI''_t\right) = \left(RE'_t; RE''_t\right) \cdot \left(\frac{1}{AFC''_t}; \frac{1}{AFC'_t}\right) - \left(C'_t; C''_t\right) \cdot \left(\frac{1}{AFC''_t}; \frac{1}{AFC'_t}\right) \tag{7}$$

The overall ROI ($ROI_{tot} \in \mathbf{F}$) of a project is calculated from the difference between the sum of all periods' revenues (RE_{tot}) and the sum of all costs (C_{tot}) divided by the average fixed capital (AFC_{tot}). Noted as upper and lower inverse function:

$$\left(ROI^{'}_{tot};ROI^{''}_{tot}\right)=\sum_{t=1}^{T}\left(RE^{'}_{t};RE^{''}_{t}\right)\cdot\left(\frac{1}{AFC^{''}_{tot}};\frac{1}{AFC^{'}_{tot}}\right)-\sum_{t=1}^{T}\left(C^{'}_{t};C^{''}_{t}\right)\cdot\left(\frac{1}{AFC^{''}_{tot}};\frac{1}{AFC^{'}_{tot}}\right) \tag{6}$$

Value benefit analysis

The value benefit analysis evaluates non-monetary costs and benefits. The described fuzzy value benefit analysis follows Puchan's methodology (Puchan 1993) based on the method of the invertible fuzzy numbers. Performing a cost/benefit analysis includes the following steps (Zangenmeister 1971): Define goals, weight goals, scale criteria and evaluate projects with respect to the goals. The difference between sharp and fuzzy VBA is that the goals are evaluated with invertible fuzzy numbers. The result is a fuzzy benefit value per evaluated alternative.

For the criteria frequently a dimensionless discrete point scale is used between 0 and 10 or 0 and 100. The higher the score of an alternative is the more favourable it is. In the following the benefit value is defined as a continuous variable in the interval [0;1]. The interval is equivalent to a point scale, since a point scale represents a defined interval and can be transformed to the interval [0;1] by a division by the maximum point value. The condition of continuity is necessary for the evaluation with fuzzy numbers.

The first step in a value benefit analysis is to specify the hierarchy of objectives. On top of the hierarchy of objectives is (non-monetary) profitability. Non-overlapping and independent goals are derived by a further refinement of the goals, i.e. splitting the goals into sub goals. At this point it is important to make sure that benefit and cost effects that have already been evaluated with the monetary procedures are not stored again in the hierarchy of non-monetary objectives. This process is being performed repeatedly until the goals represent elementary criteria. As a result, a hierarchy of objectives is developed, where only elementary goals are directly assessable. Each elementary goal must be evaluated on the basis of a measurable criterion. The criteria may have different scales and dimensions. In order to make them comparable, they must be transformed to the interval [0;1].

The importance of the defined goals usually differs. This is expressed by weighting the goals (Puchan 1993). The partial benefit values of all main goals can then be calculated by a weighted addition of the partial benefit values of their elementary goals. For the computation of the entire benefit value of a project i, the partial benefit values of all elementary goals j (n_{ij}) have to be multiplied by their absolute weight (${}^{abs}g_j$) and added up afterwards. The equation for the benefit value (see eq. 7) of a project is the same for the fuzzy value as for the sharp value. Thus the benefit value of a project i corresponds to the sum of the weighted partial benefit values of all elementary goals j:

$$N_i=\sum_j {}^{abs}g_j \cdot n_{ij} \quad ; N_i, n_{ij} \in \mathbf{F} \text{ and } {}^{abs}g_j \in \mathbb{R} \tag{7}$$

In the notation with upper and lower function:

$$\left(N^{'}_i;N^{''}_i\right)=\sum_j \left({}^{abs}g_j;{}^{abs}g_j\right)\cdot\left(n^{'}_{ij};n^{''}_{ij}\right) \tag{8}$$

(3) Implementation

The following figures illustrate the implementation of the fuzzy methods. Input data are provided by a co-operating consulting company and are taken from a real case.

The decision deals with the investment into an e-sales system. The first project alternative is a stand-alone solution of the e-sales-system (ESS, project 1). Realizing this project requires expenditures for infrastructure and organizational adjustments. The other alternative consists of an e-sales-system, a supplementing trading platform for used capital goods, and an industry directory (yellow pages). This integrated solution (IS, project 2) represents an extension of the ESS (project 1) with basically the same costs and revenues. But it causes expenditures for consulting, infrastructure and an acquisition. The retention of status quo without realizing a project is represented by pseudo project 3.

Fuzzy net present value analysis

The fuzzy NPV analysis shows that none of the two projects should be realized from a financial perspective since the average values of both projects are negative (see Fig. 7). For project 2 this decision is enforced by the fact that the maximum value is only slightly positive. However, the maximum value of project 1 is more clearly in the positive range. Therefore, it could be argued for this project as well.

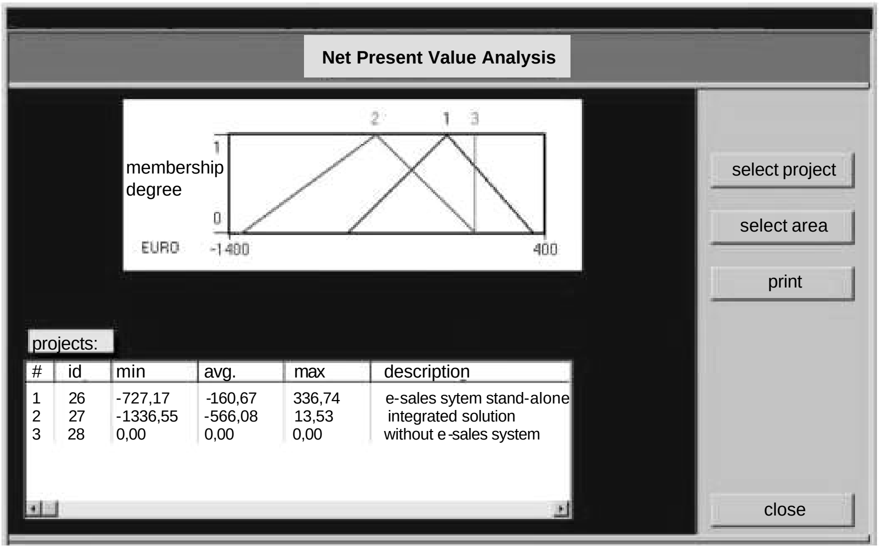

Fig. 7 Fuzzy net present value analysis

Fuzzy ROI analysis

For the evaluation of profitability, a minimum interest rate i of 15% is assumed. The average value of approximately 46% for project 1 (ESS) is clearly above the required interest rate and the minimum value is only slightly negative (see Fig. 8). In contrast, the average ROI value of project 2 is barely positive and thus clearly below i. The maximum value exceeds i only by a little. If the decision was based on these ROI values, the following conclusions could be drawn: regardless of the fact that the two fuzzy ROI functions are overlapping, project 1 is favourable and should be realized despite the small possibility of a ROI below the minimum interest rate. The largest part of the membership function of project 2 lies below the required interest rate and should therefore not be realized.

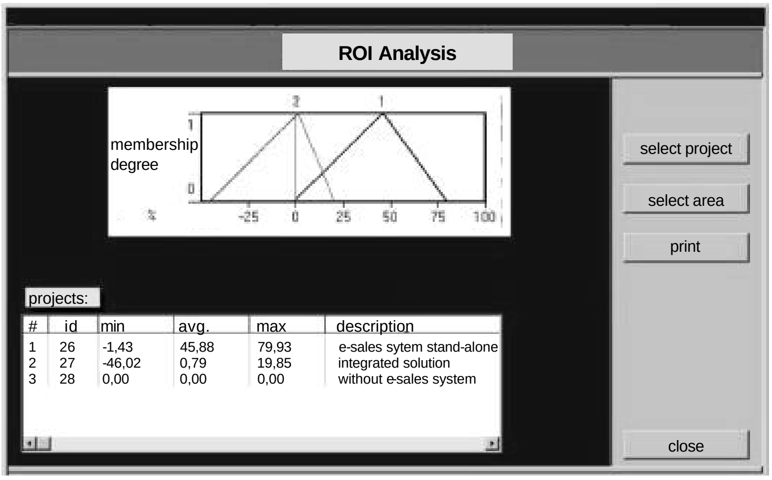

Fig. 8 Fuzzy ROI analysis

Fuzzy value benefit analysis

The results of the value benefit analysis clearly show the advantages of the two projects compared to the status quo (alternative 3 in Fig. 9). The benefit values of the two projects are close to each other, with project 2 having better values than project 1. From the non-monetary point of view, project 2 ought to be realized. The difference between the results of monetary and non-monetary approaches could be explained by the fact that a major part of the benefits of e-Business applications usually cannot be expressed in monetary terms.

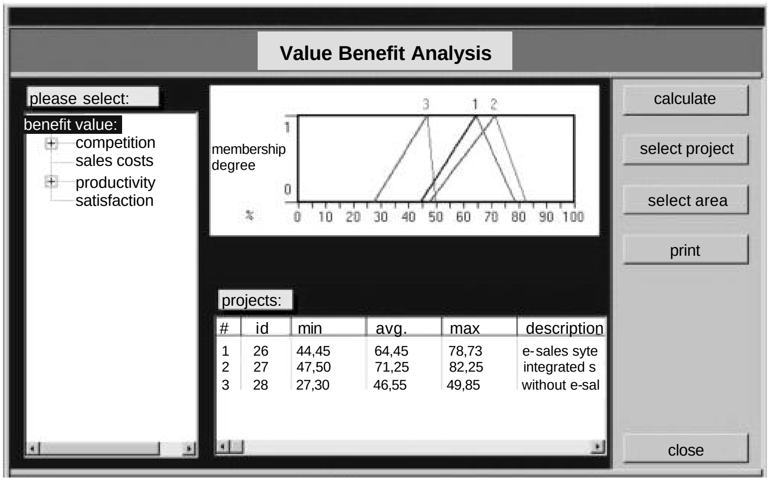

Fig. 9 Fuzzy value benefit process

5. Conclusion

In this paper a project is presented that aims at condensing the existing know-how for the design of e-Business strategies into a generic method for e-Business piloting. A support system adjusted this generic method is being developed. This paper outlines the approach and first results coming from the implementation of two software tools. Further research is required. Strategic processes in different types of industries have to be analyzed and software products have to be evaluated regarding their e-Business potential. However, the tools presented in this paper have already been tested in real cases and have proven their capability to add valuable input for e-Business strategy projects.

The support system is based on the belief that successful development and implementation of an e-Business-Strategy depends on its integration in the company's business strategy. IT can no longer been seen as a mere support of every day's work but instead is a strategic factor that differentiates companies from each other.

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