Chapter 10

DYNAMIC ROI CALCULATIONS FOR E-COMMERCE SYSTEMS

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Abstract: The introduction of eCommerce Systems poses a special challenge for estimating value payoffs in the face of uncertain future developments. Practitioners have difficulty to capture all or even some of the benefits of eCommerce Systems with existing traditional capital budgeting models. In this paper, we analyze and evaluate various ways of measuring the business value of eCommerce Systems, considering financial and non-financial, quantitative and qualitative, traditional and innovative models. We intend to identify boundaries of state of the art approaches of economic valuations and present new approaches which integrate the business value of eCommerce Systems into the traditional capital budgeting models. A case example shows an exemplarily approach for a dynamic modification of ROI calculations with the Customer Lifetime Value for CRM Systems.

Key words: ROI Calculations, eCommerce Systems, Customer Lifetime Value, Real Option Pricing Models, Economic (e)Valuations, Capital Budgeting Models

1. MOTIVATION

Amberg and Hirschmeier (2003) showed basic problem fields for the economic valuations of eCommerce projects. The following problem fields summarize the failure of existing economic valuations.

Problematic Anticipation of Benefits: IT practitioners have problems in determining the time series of inflows and outflows of an innovative technology project. Especially benefits are hard to capture in numeric values. Important decisions are more often based on intuition and experience than on quantitative analysis. Simple and static models are often preferred. Similar results can be found in the studies of Tam (1992).

Decisions on Rules of Thumb Basis: Decisions in eCommerce projects are more often based on rules of thumb such as "invest to keep up with the technology" or "invest if the competitors have been successful" than on quantitative analysis. Further investigation of the state of the art methods that were used for determining the value of IT infrastructure in practice can be found in the studies of Weill (1993).

Problematic Application at Early Planning Stages: Practitioners complain that standard evaluation procedures for IT projects are impossible to apply, particularly at early planning stages. Hochstrasser (1994) stated the same problems about 10 years ago.

Negative ROI: The problematic quantification of benefits leads to an asymmetric consideration of cost in the balance of the cost benefit analysis. ECommerce projects often have negative economic valuation results - despite of their strategic importance.

Risk of Incredibility: Many investments in new technologies start with a project status and the goal to create a positive ROI within only a short period of time. To rescue the project, many financial calculations overestimate the benefits in the first years in order to constitute a positive return on investment. Commonly, the credibility and the acceptance of these calculations is endangered.

Risk of False Rejection: Investments in innovative technology is budgeted. Companies have to overcome the problem not to routinely reject truly important investments by using simplistic quantitative techniques (Kester, 1984). This is especially important for companies with independently operating business which act under the objective to maximize the company's equity in short-term. Organizations could loose important opportunities if they strictly rely on traditional criteria to assess innovative technology benefits.

In the following we will give an overview on existing traditional economic valuations and discuss the limitations of the presented state of the art methods.

2. STATE-OF-THE-ART APPROACHES FOR ECONOMIC (E)VALUATIONS AND THEIR LIMITATIONS

Traditional Capital Budgeting Models consider monetary costs and benefits of an investment cumulated for each year over a specified period of time. The traditional methods can be divided in static and dynamic models. Dynamic methods take into account the time value of the money (e.g. net present value (NPV), internal rate of return (IRR) etc.) sometimes even

considering the inflation rate. Static methods like the payback method, the accounting rate of return (ARR), the Return On Investment (ROI) etc ignore the time value of money. Traditional Capital Budgeting Models consider the time value of money by comparing the cash outflow at the beginning of a proposed project with the anticipated cash inflows to be generated by the project. Discounted cash flows refer to the present value of a stream of payments to be received or paid in the future.

- **Return on Investment (ROI)** is the most common measure of profitability. Different users define income and investment differently when measuring ROI. Most measures of ROI relate an income statement element such as operating or net income to a balance sheet element such as stockholders' equity. The basic construction of the formula is:

$$ROI = \frac{Income}{Investment} \tag{1}$$

Return on Investment (ROI)

- The **Total Cost of Ownership (TCO)** approach was originally developed by the Gartner Group in 1987. The background was that the state of the art capital budgeting methods at that time only considered the initial hardware costs. The TCO approach takes all operating cost of the investment into account, specifically for IT investments maintenance cost, content development and management costs, training costs, license cost, consulting costs etc. The resulting ratio is a price, the cost of the investment per working place. Unfortunately there is no general systematic for this economic valuation and different TCO methods have been developed for example by Forrester Research and Meta Group.
- **Process Costing Models** (Target Costing, Activity Based Costing) try to overcome the traditional functional oriented view in accounting. With the shift of perspective the economic valuations of products can change significantly. Examples show that the economic valuations can double or halve. The process oriented costing models can contribute to acceptance of the right projects. The method is only useful for repetitive processes with a small variability of decisions.
- **Option Pricing Models:**The basic approach of option pricing is derived from physics, specifically the Brownian motion in thermodynamics. The basic mathematical construct is an exponential function. The formulas describe the distribution of the present value of the project's expected revenues. There are different models, which assume that the option value follows either a geometric, binomial (Cox, Ross, Rubinstein, 1979),

normal (Taudes et al., 1997) or lognormal (Black-Scholes (as cited in Benaroch, Kauffman 1998)) distribution. For example Taudes et al (1997) use the following formula construct:

Value of a software platform = NPV of fixed application portfolio + Option value of implementation opportunities.

$$NPV = e^{-\mu T}(V_0 e^{\alpha T} N(d_1) - IN(d_2)$$

$$d_1 = \frac{1}{\sigma\sqrt{T}}\left(\ln\left(\frac{V_0}{I}\right) + \left(\alpha + \frac{1}{2}\sigma^2\right)T\right) \qquad d_2 = d_1 - \sigma\sqrt{T} \tag{2}$$

Real Options Pricing Model

Limitations of the state-of-the-art approaches: Historically, capital budgeting models come from the time of the industrial age. Heavy machinery produced a predefined output which could easily be quantified and assigned a monetary value. However, the innovative technologies today differ completely in their characteristics from the technology of the industrial age. The strategic impact of the traditional capital budgeting models was to assure the liquidity of the company. Today, the strategic focus has shifted from the financial costs to the strategic benefits of an investment. Under this perspective, even newer approaches like the Total Cost of Ownership (TCO) can be counted to the traditional cost-oriented approaches as the method focuses on the costs, not on the benefits.

The option pricing model is a methodical improvement for economic valuations of CRM Projects as the methodology takes the opportunities into account and provides a better characterization of the investment's true value than would a net present value. The most critical aspect of the option pricing value method is at first sight the estimation of the future opportunities because the developments depend on the economic environment of the company and its industry, world trends and other events beyond the control of the company. Additionally, questions of initiation and pacing of investment have to been determined. The mathematical approach does not provide any help in quantifying the relevant parameters.

Secondly, Real Option quantifications are always involved in questions of organizational change and decision making. Strict real option assumptions do not allow applying the approach for organizational change. Adner & Levinthal (2002) show technical violations and point out the inherent limitations and boundaries of applicability of real options for economic valuations for organizational design and management.

3. PROJECT CLASSES AND METHODICAL REQUIREMENTS FOR ECOMMERCE PROJECTS

The limitations of the state-of-the-art approaches lead to a need of methodical support for the ROI calculations of eCommerce projects. In the following we present a set of project classes according to the problems that arise when calculating ROI of eCommerce projects with traditional capital budgeting models and the solutions that practitioners have found to assess the benefits of an investment.

Projects with Qualitative Benefits (Project Type I): The shift towards intangible benefits leads to a class of projects where benefits are no longer quantified with a monetary value. Qualitative scoring models are used to assess the values of each project so that the projects can be ranked in the order of importance. The ordinal values are often transferred into numerical values on quantitative scales, but the fundamental evaluation rests qualitative. The Balanced Scorecard is one of the best known scoring approaches. In its finance dimension it offers the measurement of benefits through qualitative scoring. Scoring models rely in their calculation of value for eCommerce Projects on the executives' experience and judgements. If experiences with eCommerce projects are rare, the evaluation process could be problematic. A common criticism that is brought to Scoring models is that they leave plenty of room for political influences as the scores and weight of single criteria must be found subjectively. Furthermore, economic valuations based on scoring models are confronted with a number of problematic and implicit assumptions such as full substitutability of criteria and uniform ordinal scales.

Projects with Long-term Benefits (Project Type II): The shift of the time frame for benefits realizations towards a long-term perspective leads to a class of projects, which are characterized through their future potentials and enabling function. Most benefits of these projects are realized in related successive projects. Infrastructure projects are a typical project class with this characteristic. The benefits of these related successive investments depend on variables of the social and technical surrounding like the development and acceptance of electronic standards. These future potentials are highly volatile and the benefits cannot be calculated deterministic.

Projects with Retrospective Success Measurement (Project Type III): The projects of this class are characterized through an economical retrospective on an investment which has already been made. Usually, the economic evaluation is based on an actual/target comparison of the related processes. The main difficulty is based on the fact, that state of the art of project management does not implement any tools which support a future

quantification of the efficiency progress and optimization efforts. The development and deployment of appropriate instruments for the measurement of the economical success is an important in the as a controlling tool function for the identification of further potentials for optimization.

Projects with No Accounting Effective (Atomized) Benefits (Project Type IV): This project class is characterized by quantization problems of cost savings. The cost reductions are atomistic distributed on the different cost centers, so that they don't affect the accounting or balance. Like energy particles in quantum physics, the timely savings can only be effective as cost savings, until they reach a certain value. For instance timely savings in employee processes do only have an effect on the accounting if they are high enough to replace a complete position; otherwise the savings are accepted by the controlling. This problem is forced by different perspectives of two different business units, one which is responsible for the Controlling and another, which is responsible for the introduction of IT. Essentially, this is a problem of organizational structure and it can be resolved through appropriate modification of the existing cost centers. An appropriate economic evaluation should be able to equally support both perspectives.

We use a 2x2 matrix grid to point out the need for methodical support. The matrix consists of two dimensions: One dimension shows the state-of-the-art methodologies:This dimension is on the horizontal scale and ranges from deterministic to volatile: The degree of quantification complexity is positively related to higher requirements of the mathematical back-ground and applied formula. The second dimension refers to the typology of benefits in the ROI calculations. The dimension on time perspective is shown on the vertical scale and distinguishes tangible and intangible benefits. Each of the four quadrants can be identified at least with one project class (figure 1).

Methodical Requirements: Projects with a retrospective success measurement and projects with no accounting effective (atomized) benefits can be calculated deterministic. The projects with qualitative benefits and projects with long-term benefits are characterized by a high volatility of their future economic developments. These project classes cannot be calculated in a deterministic way and the state of the art methods of the traditional capital budgeting methods are not suitable for this degree of quantification complexity. There is a need for the development of new methods for the economic evaluation of the projects of this class. The next chapter presents new approaches which contribute to solve the problem classes.

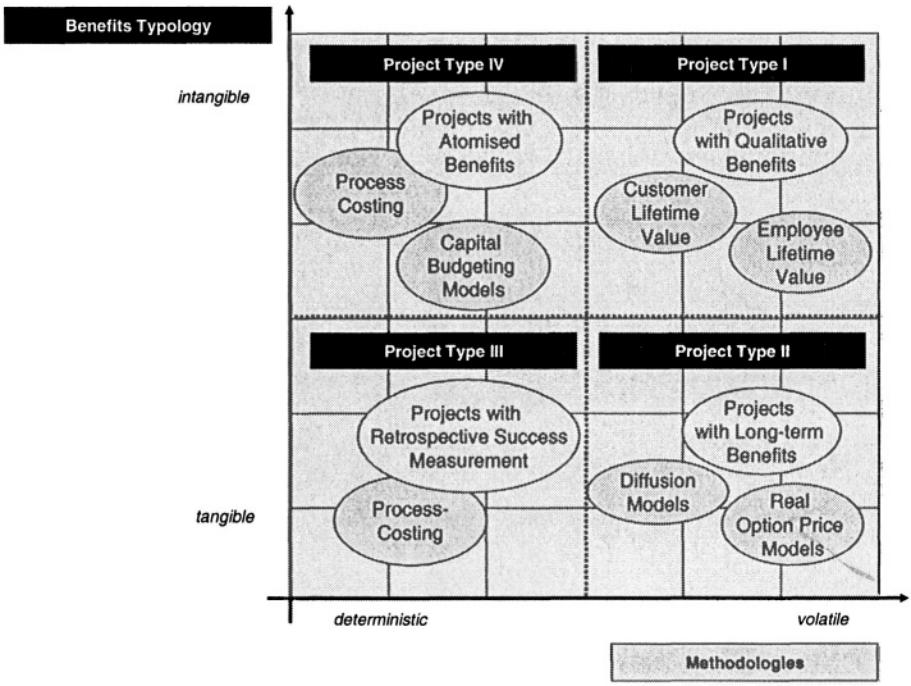

Figure 1. **Project Classes and State-of-the-art Methodologies**

4. DYNAMIC ROI CALCULATIONS FOR ECOMMERCE SYSTEMS

Amberg and Hirschmeier (2003) presented new approaches known in Management Information Systems literature like Real Option Pricing Models, Process Costing, Scoring Models (Balanced Scorecard), Customer Life Time Models and Business Dynamics Models and discussed them with regard to the practical advantages and their suitability for the economic evaluation of eCommerce projects. In the following we will present an approach that integrates the existing models to an approach for the economic evaluation of eCommerce systems.

The Balanced Scorecard is a state of the art of method for the controlling and evaluation of eCommerce Systems. The Balanced Scorecard identifies four dimensions for an equal and balanced consideration of strategic values of an eCommerce System. The four dimensions cover the processes, the customers, the employees and the costs of an eCommerce System. Except the cost dimension, the dimensions focus on intangible and soft factors which are measured on a qualitative scale:

- **Processes:** The Processes dimension consists of management ratios and operating figures measuring the improvement, effectiveness and efficiency of the business processes.
- **Customers:** The Customer dimension measures qualitatively strategic values like customer loyalty, client satisfaction, corporate image, customer retention, etc.
- **Employees:** The Customer dimension measures qualitatively strategic values like enhanced employee goodwill, increased job satisfaction, skill development and adoption of new knowledge, etc.
- **Costs:** The Cost dimension focuses on financial figures and ratios like revenue mix, service costs, charges, cost structures, etc.

We present in the following an approach for the economic (e)valuation of eCommerce investments which explicitly focuses on the equal and balanced quantification of soft and intangible facts. According to the Balanced Scorecard we consider the business values of processes, customers, employees and the costs to measure the economic benefits of an eCommerce investment. We suggest the economic concepts of Process Costing, Customer Lifetime Value, Employee Lifetime Value, Total Cost of Ownership and Real Option Price Value to quantify the different values and their monetary development over time.

- **Process Efficiency:** Process Costing is the state of the art method for economic evaluations of an investment. The effected business processes are compared between now and a point of time in the past or in the future to quantify the economic improvement of the process efficiency.
- **Customer Lifetime Value (CLTV):** The Customer Lifetime Value is usually defined as the total net income a company can expect from a customer (Novo 01). The exact mathematical definition and its calculation depend on many factors as the industry, etc. The sum of values follows in its development over time usually a Gaussian e-function. This statistical model can be used to anticipate the future benefits development of the customer based benefits of an eCommerce investment.
- **Employee Lifetime Value (ELTV):** To quantify the benefits of the employee related benefits, one could define an Employee Lifetime Value analogous to the Customer Lifetime Value. Accordingly the Employee Lifetime Value can be defined as the total net income a company can expect from an employee. We suggest a similar basic mathematical definition and an equivalent calculation to the Customer Lifetime Value.
- **Total Cost of Ownership (TCO):** The Total Cost of Ownership (TCO) takes all operating cost of the investment into account, specifically for IT investments maintenance cost, content development and management costs, training costs, license cost, consulting costs etc. The resulting ratio

is either a price, the cost of the investment per working place or the total sum of accumulated costs.

- **Future Potential through Real Option Pricing Value (ROPV):** Real Option Pricing Models allow assigning a monetary value to the volatility of related future projects of an investment. There have been several models proposed in Management Information Systems literature. Stickel 1999 shows that innovative projects can be valuated by European call options and that related future projects can be valuated by compound options. The basic mathematical construct of all proposed approaches is an exponential function.

The four categories of benefits namely process efficiency, customer value, employee value and benefits from related future investment can be combined to an integrative ROI calculation, which is schematically shown in equation 7.

$$ROI = \frac{Income}{Investment}$$

$$ROI = \frac{Process\_Efficiency + \sum CLTV + \sum ELTV + Future\_Potential}{Total\_Cost\_of\_Ownership} \quad (3)$$

Dynamic ROI Calculation
CLTV = Customer Lifetime Value
ELTV = Employee Lifetime Value
Future Potential = Benefits of Related Successive Projects

As the concepts of Total Cost of Ownership and Process Costing are state of the art methods, we will focus in the following on the concepts of Customer Lifetime Value, Employee Lifetime Value and Real Option Price Value and show these concepts in more detail.

5. CUSTOMER / EMPLOYEE LIFETIME VALUE MODELS

The Customer Value describes the economic relevance of a customer, meaning his tangible and intangible contributions to business objectives. A recent study conducted by Cambridge Technology Partners Germany used a Customer Lifetime Value Approach for ROI calculations of CRM investments (Graf et al., 2003). We will illustrate in this example an approach for the economic valuation of a CRM Project in the assurance

sector with a dynamic ROI calculation. The calculations cannot be shown in full detail due to confidentiality aspects.

In CRM Projects the customer behaviour plays the important role for the development of the benefits. To quantify these benefits in this specific focus of the assurance business the benefits calculation was conducted with the customer lifetime value (CLTV). The following equation shows the formula, which is used for the benefits calculations based on the CLTV (Graf et al, 2003):

$$CLTV = \sum_{i} \sum_{k=0}^{L-A} A_{ik} * \left[D_{ik} * E_{ik} * (1 - W_{ik}) * \left(\frac{1}{1+p} \right)^{k} + \sum_{s=k+1}^{L-A} E_{is} * \left(\frac{1}{1+p} \right)^{s} * \prod_{j=k}^{s} (1 - W_{ij}) \right] \quad (4)$$

Customer Lifetime Value Method

A = current customer age
L = customer life expectancy
K = current calendar year
Eij = expected customer revenue in branch i in year j after K
Wij = customer's probability of cancelling in branch i in year j
Dij = annual insurer's share of customer in branch i

The precise calculations can be viewed in the study published by Cambridge Technology Partners (Graf et al., 2003).

Suitability of the Lifetime Value Concepts for eCommerce Projects: The integration of dynamic elements like the CLTV into the ROI calculation leads to an s-shaped curve of ROI distribution, which is typically for innovation diffusion processes. The s-shaped ROI development represents a more realistic anticipation of the value development of the CRM investment and provides a much more authentic and credible ROI calculation. The Life Time Value Models are an interesting approach as they capture intangible benefits and important system behaviour like acceptance on a macroeconomic perspective. Problematic is the definition of the function parameters as estimating the future development of the lifetime cycle, qualitative components and changes of retention effects in the future and the complex relationship between building up and skimming the potential value.

6. CONCLUSION

The application of traditional tools beyond their actual boundaries overstresses their internal logic as a tool and framework and undermines their effective application. A helpful approach could be to analyze IT-economics from a macroeconomic point of view. Statistical approaches over

adaptive behaviour and system dynamics describe the overall development and can contribute to a new way of determining the costs and benefits of changes processes through eCommerce projects. We showed an exemplary approach how innovation diffusion models can be integrated in economic valuations for customer relationship management systems with the Customer Lifetime Value.

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