Project Selection Directed By Intellectual Capital Scorecards

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Abstract	Management of intellectual capital is an important issue in knowledge intensive organizations. Part of this is the composition of the optimal project portfolio the organization will carry out in the future. Standard methods that guide this process mostly focus on project selection on the basis of expected returns. However, in many cases other strategic factors should be considered in their interdependence such as customer satisfaction, reputation, and development of core competences. In this paper we present a tool for the selection of a project portfolio, explicitly taking into account the balancing of these strategic factors. The point of departure is the intellectual capital scorecard in which the indicators are periodically measured against a target; the scores constitute the input of a programming model. From the optimal portfolio computed, objectives for management can be derived. The method is illustrated in the case of R&D departments.	
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PROJECT SELECTION DIRECTED BY INTELLECTUAL CAPITAL SCORECARDS

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ABSTRACT

Management of intellectual capital is an important issue in knowledge intensive organizations. Part of this is the composition of the optimal project portfolio the organization will carry out in the future. Standard methods that guide this process mostly focus on project selection on the basis of expected returns. However, in many cases other strategic factors should be considered in their interdependence such as customer satisfaction, reputation, and development of core competences.

In this paper we present a tool for the selection of a project portfolio, explicitly taking into account the balancing of these strategic factors. The point of departure is the intellectual capital scorecard in which the indicators are periodically measured against a target; the scores constitute the input of a programming model. From the optimal portfolio computed, objectives for management can be derived. The method is illustrated in the case of R&D departments.

Keywords: Optimal portfolio, knowledge management, intellectual assets, knowledge capitalization.

1. INTRODUCTION

"Knowledge is power." Yet, managers still determine their strategies mostly on the basis of financial indicators and measurement tools. The future investments of shareholders are mainly determined by the short-term profitability of their shares. In general there is little attention for the effective management of strategic factors that are difficult to measure like customer satisfaction, development of core competences and new knowledge. One of the reasons is also the lack of tools that enable managers to take into account these factors and define a balanced knowledge based strategy.

This is especially a challenge for knowledge intensive organizations (KIO 's), since their future performance depends only partially on profit figures. The type of assets in knowledge intensive organisations varies widely, ranging from patents in the case of research laboratories to best practices on how to handle defaulters in the case of a law center. KIO 's share characteristics that distinguish them from plants, the most important being the constant need to develop new valuable knowledge (Daniels et al, 2002), (Mouritsen, 2001) and (Noordhuis, 2002).

Some KIO 's, like R&D departments, have a zero profit target since their core business is to support business units with the realization of new products or new methods. The main value driver of R&D departments is the development of new knowledge. New knowledge is mainly developed by conducting projects in the front line of expertise, rather than projects that be solved by routine methods right from the shelf. A KIO that focuses too much on the latter will undermine the future potential of its intellectual capital. KIO's have a highly invariable capacity, especially in the short run (Daniels et al, 2002). Knowledge workers possess a high level knowledge and specific skills, and due to the complexity of their work it may take up to a few years before new employees becomes fully productive. A downside of the invariable nature of the capacity is that in times of increasing demand a shortage of capacity can easily arise. This implies that not all the projects be realized and a project selection tool is needed. A general set up for such a tool, based on an intellectual capital scorecard approach is presented in this paper.

The objective is not the maximization of expected return of projects, like in the traditional project selection tools (Martino, 1995). Instead we focus on factors into account that stimulate the development of intellectual capital such as the growth of new knowledge and improvement of customer satisfaction.

2. INTELLECTUAL CAPITAL

There is no widely accepted definition of intellectual capital. The basic idea behind the notion of intellectual capital is that it explains the difference between market value and accounting book value. The difference is (in practice) always positive, because stockholders value a company higher than an accountant does. This is not surprising since one of the basic principles in accounting is the so-called prudence principle. The prudence principle states that:

- Credits should not be valued higher then their true value;
- Debts not lower then their true value;
- Results should not be flattened.

In practice, this means that valuations in books are always rounded off downwards. Another common characteristic of conservative accounting methods is that all kinds of intangible assets that are hard to make tangible, are not recorded in financial statements. These are exactly the components that one tries to identify and quantify in intellectual capital statements. Combined, these components explain the difference between market value and book value. A structured way to define intellectual capital, subdividing it into several components is given in (Edvinsson, 1997):

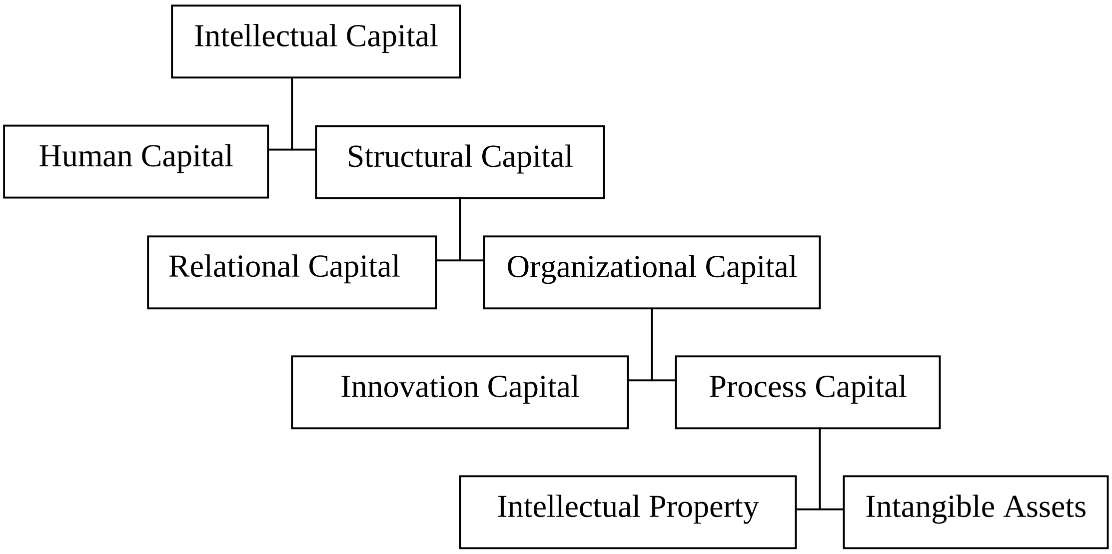


Figure 1: Decomposition of intellectual capital into components according to Edvinsson.

For further explanation and discussion of the components the reader is referred to (Edvinsson, et al, 1997).
In the next section we shortly summarize the most important methods to express the value of intellectual capital. The valuation of components of intellectual capital is one of the inputs of the project selection tool presented in section 4.

3. METHODS FOR MEASURING

Over the last decade some methods have been proposed to measure components of intellectual capital. A comprehensive overview of the measurement models can be found in (Sveiby, 2001a). A distinction is made between *monetary intellectual capital measuring models* that express the value of intellectual capital in money, and *non-monetary intellectual capital measuring models* that measure the intellectual capital in non-monetary ways. It is common to distinguishes 4 categories of intellectual capital measuring methods (Sveiby, 2001a) of which the first 3 listed are monetary:

- Direct Intellectual Capital methods (DIC)
- Market Capitalization methods (MCM)
- Return on Assets methods (ROA)
- Scorecard methods (SC, non-monetary).

For the scheme proposed here scorecard methods put together a better valuation framework, because monetary methods only cover a limited number of intangibles (Bontis, 1998), (Ballantine et al 1998).
Scorecard methods became well known after introduction of the *Balanced Scorecard* (BSC). Kaplan and Norton stated that managers need a multidimensional measuring-system to support their decisions (Kaplan et al, 1996). This system should also be able to deal with non-financial indicators, like product quality and customer satisfaction.
The difference between a BSC and intellectual capital scorecards (ICS) is mainly in the business process that is being assessed. The balanced scorecard is based on the value chain concept, while intellectual capital scorecards provide statements about the components of intellectual capital (Sveiby, 2001b). The BSC groups its indicators in four perspectives; the ICS considered here consists of five (Financial, Customer, Process, Human, and Renewal & Development). These perspectives are based on the components of intellectual capital mentioned previously.

All indicators on the ICS have a relative value. This is because the indicators are linked together and thus interdependent. As a consequence the values of indicators cannot be compared to previous values of the same indicators, or values of the same indicators in a different branch of industry. The main purpose of providing an ICS is to improve the visibility of intellectual capital of the firm, both for internal purposes and external reporting. Information provided by the ICS should play an important role in management decisions about the future development of the main value drivers in KIO's. In this paper we propose a method to implement a strategy to manage intellectual capital based on ICS and project selection. We assume that the key activity of the organization is the realization of projects. Not all projects can be carried out because of capacity constraints. We also assume that the projects contribute differently to the development of the key factors on the ICS. The optimal portfolio of projects will contribute maximal in reaching the targets of the ICS.

4. CASE STUDY

This section goes on describing the decision support tool for project selection. We also show how the tool can be applied in an industrial R&D environment. Indicators and targets are derived from the ICS. In the example presented here the most important are: reputation, project size, new competence development, customer satisfaction and risk. The indicators are periodically measured against a target. The target is the desired value of the indicator at the end of the timeframe (e.g. a year). If the actual value is (much) below the target, the weight of this factor is increased in the model. The parameters of the projects are estimated by management and experienced experts in the R&D department. They may frequently change when different scenario's or what if studies are performed. The final outcome of the process is an optimal project portfolio. The portfolio is optimal in the sense that the resulting future state is as close as possible to the predefined targets. It is not guaranteed that the targets will actually be reached, since many of the parameters in the model are soft and capacity or risk constraints may restrict the number of projects that can be selected. However, one expects that any other portfolio would result in a state further away from the targets. The parameters based on expectations and rules of thumb are set ex ante, the final result, however can only be inspected ex post, at the end of the time frame considered. Below the operational steps to complete the model are listed. The prototype is implemented in Microsoft Excel 2000.

Step 1: Input from ICS.

- *Select relevant indicators from the scorecard.*
  The indicators in the ICS that are considered to be the most relevant for project selection form the basis for the optimization tool. They are denoted by I_1, I_2, …, I_m. In figure 2 an example of the indicators selected is given.
- *Determine the actual and target values of the relevant indicators on a 5 point-scale.*
  Throughout the project, the same scale should be used to indicate scores. In our studies we have chosen a 5-point scale. An example of scores and targets are depicted in figure 2.
- *Determine the weight of each indicator on the scorecard in a 5-point scale.*
  The weight should depend on two factors. Indicators that are crucial for the R&D strategy should get a higher weight factor. The second factor that should be taken into account is the gap between the target of the indicator and its actual value. If this gap is bigger than acceptable, the weight can be raised to improve the performance of this indicator. Integration of the intellectual capital scorecard and the project selection model can partially automate this process. The final weight of indicator I_i is denoted by α_i.
- *Compute the capacities of different areas of expertise in the period under consideration.*

The limits on the availability of expertise determine the capacity constraints. We assume that for each area of expertise a number of hours TC_k is available during the time period considered (figure 3).

Step 2: The project parameters.

- *Estimate the contribution of each project to the different indicators.*
  For each project management should estimate the expected contribution of the project to the indicators selected in step 1.The contribution of a project i to indicator j is I_{ij}.
  denoted by:
- Estimate the capacity-requirements for each project. This results in a capacity matrix C_{ik} , the capacity required for project i of type k.
- For each project β_i indicates if the project is included in the portfolio (β_i =1) or not (β_i =0).

Step 3: Constraints.

- *Capacity constraints:*
  The number of constraints depends on the number of capacities. Every constraint states that the amount of capacity used should be less or equal than the total amount available:

$$\sum_i \beta_i * C_{ik} \leq TC_k$$

- *Risk constraints:*
  We assume that each project has a certain probability p_i to fail. The probability can be estimated using historical data and consulting of experienced engineers. The natural risk constraint is that the probability that k or more projects fail is less then a certain threshold. This can be mathematically expressed by:

$$f_k(\beta_1 p_1, \beta_2 p_2, ..., \beta_n p_n) \leq \varepsilon_k,$$

f_k can be computed using the elementary risk factors p_i see appendix A. Risk factors are not taken account in the case at hand.

Step 4: The objective function.

- *Determine the value of each project.*
  This is done by adding up the individual score of the project for each indicator:

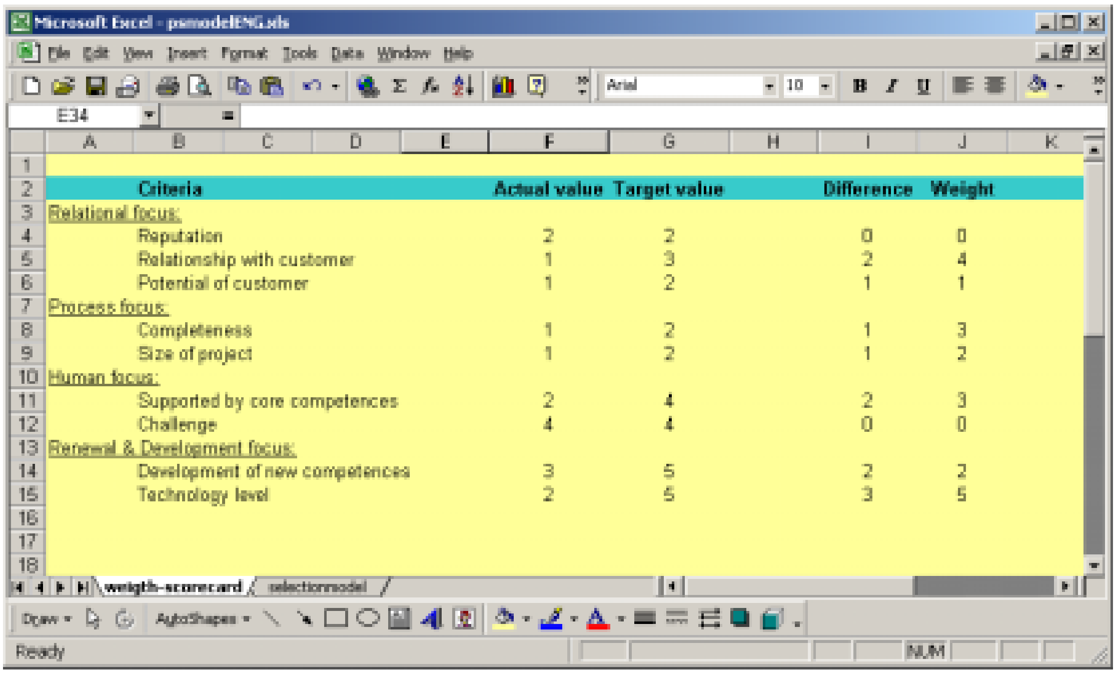
$$V_i = \sum_j \alpha_j * I_{ij}.$$

We expect that projects with higher V_i , will contribute more in realizing the targets at the end of the timeframe.

- *Define the overall objective function.*

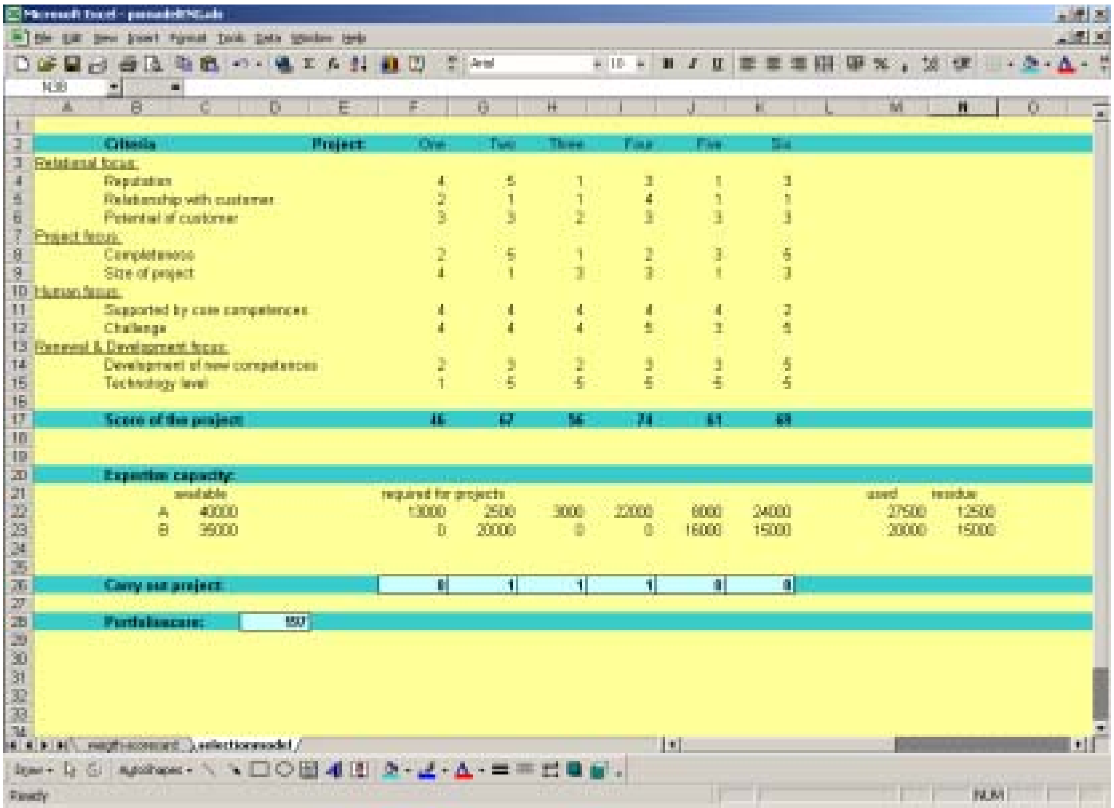
$$TV = \sum_i \beta_i * V_i.$$

here TV is the total portfolio value.



Criteria	Actual value	Target value	Difference	Weight
Relational focus:				
Reputation	2	2	0	0
Relationship with customer	1	3	2	4
Potential of customer	1	2	1	1
Process focus:				
Completeness	1	2	1	3
Size of project	1	2	1	2
Human focus:				
Supported by core competences	2	4	2	3
Challenge	4	4	0	0
Renewal & Development focus:				
Development of new competences	3	5	2	2
Technology level	2	5	3	5

Figure 2: Intellectual capital scorecard with weight-factors.



Criteria	Project: One	Two	Three	Four	Five	Six
Relational focus:						
Reputation	4	5	1	3	1	3
Relationship with customer	2	1	1	4	1	1
Potential of customer	3	3	2	3	3	3
Project focus:						
Completeness	2	5	1	2	3	5
Size of project	4	1	3	3	1	3
Human focus:						
Supported by core competences	4	4	4	4	4	2
Challenge	4	4	4	5	3	5
Renewal & Development focus:						
Development of new competences	2	3	2	3	3	5
Technology level	1	5	5	5	5	5
Score of the project:	46	67	56	74	61	69

Expertise capacity:	available	required for projects						used	residue
A	40000	13000	2500	3000	22000	8000	24000	27500	12500
B	35000	0	20000	0	0	16000	15000	20000	15000

Carry out project:	0	1	1	1	0	0
Portfolioscore:	197					

Figure 3: Example of project scores and optimal portfolio.

In the case at hand of 6 projects 3 are part of the optimal portfolio with total value TV=197. In practice it will be interesting to see which constraints are active in the optimal solution. The corresponding elasticity determines the increase in the object function. In the example presented, a slight increase in capacity of type A (500) would yield a higher value of the objective function (TV=243). The actual value of indicators is continuously influenced by the projects being carried out at that moment. Within the time frame circumstances change; old projects will be completed, new opportunities may arise and capacity might leave or enter the firm. Therefore, in the majority of cases, several steps must be repeated within the time frame considered.

5. CONCLUSION.

In this paper a method for project selection based on intellectual scorecards is presented. The program should serve as a management instrument to improve forward looking information about intangible assets in knowledge intensive organizations. On the basis of the outcomes of the program, management decides which projects should be carried out in the time frame under consideration. The tool may also be used to guide acquisition of new expertise.

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APPENDIX A: COMPUTATION OF RISK SCORE

The overall risk score of the project portfolio can be computed from the individual risk factors of the projects. The probability that k or more projects fail can be written as:

$$f_k(p_1, p_2, \ldots p_n) = \sum_{X \geq k} \prod_{i \in x} p_i \prod_{j \in x^c} (1 - p_i),$$

where the sum extends over the index sets of k or more elements. If we write:

$$p_i = \exp(\pi_i)$$
$$1 - p_i = \exp(\sigma_i).$$

We get:

$$f_k(p_1, p_2, \ldots p_n) = \sum_{X \geq k} \exp(\sum_{i \in x} \pi_i) \exp(\sum_{j \in x^c} \sigma_j)$$

$$= \sum_{X \geq k} \exp(R(X))$$

where *R(X)* can be computed for each subset X of {1,2,…,n}.

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