A Strategic Model for Consolidating BSC Measures
Based on the Desirability Function:
A Case Study of a Website Company

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Abstract

Following the idea of “what you measure is what you get,” this paper discusses the necessity to improve managing and planning firms’ service based on performance evaluation. The Balanced Scorecard (BSC) has been used as a tool for suggesting measures that can evaluate performance of a company by considering both financial and non-financial perspectives. The current BSC technology does not provide techniques to formally define, verify, implement, consolidate and analyze the performance measures. Therefore, we developed a model for deriving and analyzing the BSC score. This model provides a normalization process to reflect characteristics of the BSC performance measure and a computation process to derive the total score. The model proposed in this paper would provide executives with the single total score as well as the corresponding information model for interpreting the information provided. The model developed here consists of the following three phases: collection phase, calculation phase and decision making phase. The suggested model is illustrated through a case study in each phase. The results of the case study proved usefulness of our model.

Keywords: Balanced Scorecard, Desirability Function, Total Score

1. Introduction

In today’s strong competitive environments, firms should be agile and flexible. Therefore, availability of the right information at the right time based on performance evaluation has become critical (Banker D. R., et al., 2004). It is essential to improve managing and planning firms’ service based on performance evaluation (Abran and Buglione, 2001), because “what you measure is what you get” (Kaplan and Norton., 1992).

The traditional financial performance measures worked well for the industrial area, but they are out of step with the skills and competencies companies are trying to master today. In other words, no single measure about finance can provide a clear performance target or focus attention on the critical areas of the business (Kaplan and Norton., 1992).

The balanced scorecard (BSC) presents managers with four different perspectives from which to choose measures. It complements traditional financial indicators with measures of performance for customers, internal processes, and learning and growth activities (Kaplan and Norton, 1994). Therefore it enables companies to track financial results while simultaneously monitoring progress in building the capabilities and acquiring the intangible assets they would need for future growth (Kaplan and Norton., 1996). It is intended to link short-term operational control to the long-term vision and strategy of the business. In this way a company focuses on a few critical key ratios in meaningful target areas (Olve and Wetter, 1999).
As [Figure 1] shows, the continuous process centered on the BSC combines the four perspectives.

![Diagram of the BSC model]

[Figure 1] Managing Strategy: Four Processes (Kaplan and Norton, 1996)

To implement the part of strategic feedback and learning in the four processes to form a cycle, it is essential to derive the total score that helps a company to know its strategic achievement level. (Abran et al., 2003). By comparing the total score at different time stamps, we can identify the core problems of the company. Furthermore, if we analyze the differences of the normalized value between companies based on the same BSC measure, we can know the efficiency and effectiveness of each division in a company.

However, the units of the BSC performance measure differ depending on a certain perspective. For example, the unit of the BSC performance measure related to cost or benefit in the financial perspective is in dollars, while the unit related to customer satisfaction in the customer perspective is in the form of a rating, since customer satisfaction is evaluated through a survey. Likewise, other units differ from one perspective to another since those perspectives have different characteristics. This discrepancy in the units causes problems when calculating the total score. Therefore, we need to normalize all the performance measures having different units to compute the total score.

Even though any performance measures above the minimum value would be acceptable, management might find the values considerably above the minimum value highly desirable. On the other hand, having the value of the performance measures considerably above the minimum value are not of critical importance.

Managers consider that all performance measures are important at the same level. In fact, some of the measures critically influence the strategic accomplishment, while the other measures do not have a direct effect. So, considering the relative weight for consolidating the normalized value is needed.

However, in the existing BSC evaluation model, authors suggested a relative satisfaction level of BSC perspectives (Kim et al., 2002) as well as consolidating methodology without considering normalization methods that would reflect the characteristics of the BSC performance measures (Abran and Buglion, 2003). Therefore, we will develop the methodology for deriving the BSC total score the results of which will provide a normalization process to reflect the characteristics of the BSC performance measure and a computation process to derive the total score. The availability of the total score could, in turn, lead to the establishment of standard sets of consolidated measures and to the institutionalization of internal–external benchmarking practices. Furthermore, organization
can establish strategy and find the critical part to achieve their strategy based on the normalized value and the total score.

This paper is organized as follows. First, section 2 of the paper covers the existing BSC evaluating model and the consolidating model for computing the total score. The model for deriving the BSC total score is developed in section 3. The suggested model is illustrated through a case study in sections 4, 5, 6. Finally, we conclude our study with emerging issues in the area of deriving the total score.

2. Literature Review

2.1 Study on deriving the total score

Geisler (1995) presented an integrated cost-performance model to consolidate cost and performance assessment of research and development evaluation (R&D). In the cost model, the total cost of R & D was calculated based on aggregated costs at each progressive stage in the R&D. The performance model was based on the development of the key output indicators for each of stages in the downstream process of R&D impact assessment. To suggest the overall index, each indicator was measured by a small set of measures using the same unit. The index of the overall value was derived as a weighted combination of its indicator. However, the model was too over-simplified to adequately reflect the multi-dimensional nature of the performance. Thus, the type of model does not meet the analytical requirements of management when various viewpoints must be taken into account simultaneously, since the BSC performance measure has different unit.

Buglione and Abran (2002) proposed the Quality factor + Economic, Social, and Technical dimensions (QEST) nD model to obtain a richer multidimensional, combined view of performance measurement. The extension of the QEST model to n possible dimensions was called QEST nD. The QEST model is a 3D geometrical representation of performance for software projects using a tetrahedron. The QEST model consists of the three dimensions (E, S, T) in the space corresponding to the corners of the pyramid’s base and the convergence of edges to the P vertex, which describes the top performance level. However, this model imposes the following constraint: all sides must be equal.

![Figure 2] QEST Model (Buglione and Abran, 2001)

2.2 Method to consolidating the BSC performance measure

Abran and Buglione (2003) used a software performance measurement model, the QEST nD for consolidating value of the BSC performance measure. Based on the QEST model, the single perspective value and the overall BSC value were developed. Since the QEST model handles the normalized value, the upper threshold and the lower threshold are gathered in order to derive the normalized score. However, the combination of the upper threshold, the
lower threshold and the real value solely does not reflect the characteristics of each BSC performance measure in the normalization process.

There are objectives classified into three types: a larger-the better (LTB)-type objective, a smaller-the better (STB)-type objective and the nominal-the-best (NTB) type (Jeong & Kim, 2005). However, despite the same value if the measures, the normalized value can be different according to the manager decision. The main intention of the methodology proposed in the following sections is to overcome these deficits.

3. Proposed model
We developed a model for acquiring the normalized value to reflect the characteristics of each performance measure and for deriving the total score, based on the desirability function. The model developed here consists of the following three phases: collection phase, calculation phase & decision making phase.

The model for deriving the BSC total score is a process that assesses the effectiveness of a company. As [Figure 3] shows, the first phase in this process is to investigate the value related to performance measure. Once this process is completed, the next step is to survey how much each measure influence strategic objectives. Based on the relative weight and the real value of the performance measure, the next phase is to calculate the desirability value by the use of the desirability function. The geometric mean of the desirability value becomes the total score. In the last phase, compared to different total scores of each time period or to the total score of another company, the total score demonstrates the level of effectiveness of a company. Furthermore, this model can show the core parts of a company to where a certain strategy is necessary to be applied using the importance-score diagram. Based on this information, a company can establish the strategy to gain competitive advantage.

<table>
<thead>
<tr>
<th>Performance measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLLECTION PHASE</td>
</tr>
<tr>
<td>Determine $W_i$</td>
</tr>
<tr>
<td>Determine type</td>
</tr>
<tr>
<td>LTB, STB, NTB</td>
</tr>
<tr>
<td>Extract $y_i, y_i^{min}$ &amp; $y_i^{max}$</td>
</tr>
<tr>
<td>Decide $r$</td>
</tr>
<tr>
<td>Extract $y_i, y_i^{min}, y_i^{max}$ &amp; $C_j$</td>
</tr>
<tr>
<td>Decide $s$ &amp; $t$</td>
</tr>
<tr>
<td>CALCULATION PHASE</td>
</tr>
<tr>
<td>Construct the desirability function</td>
</tr>
<tr>
<td>Derive the total score</td>
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<tr>
<td>DECISION MAKING PHASE</td>
</tr>
<tr>
<td>Analyze the total score of time periods</td>
</tr>
<tr>
<td>Analyze importance-score diagram</td>
</tr>
<tr>
<td>Establish strategies</td>
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</tbody>
</table>

[Figure 3] The model for deriving the BSC total score
4. Collection phase
Suppose, a company (further denoted as company M) is an entertainment portal that provides multimedia e-cards, music videos, advertising, flash games and animation. As a preliminary study, we interviewed the president of company M in order to collect background information about the company. The major sources of profits of company M are: (1) sales of flash animation, (2) development of web sites/contents for its clients, (3) e-mail marketing for its clients, and (4) web advertising using flash animated greeting card. However, because of its short history, company M has not yet generated substantial profits from its web sites.

Data collection was undertaken from October 2002 to December 2003, through interviews, internal questionnaires, and Web log analysis. Time related data, such as revenue, sales, cost, and site traffic, were collected during 1 year. The measures were used according to the specific mission and goals of company M. Among the six perspectives, some metrics of customer perceived value and the Web site interface was evaluated by a questionnaire. A ten-point scale response format, which ranged from 1 (highly dissatisfied) to 10 (highly satisfied), was provided. The questionnaire was sent to 250 randomly selected customers of company M and 52 responses were returned.

4.1. Determine $W_i$

The relative weights for the performance measure can be calculated using the Analytic Hierarchy Process (AHP) (Saaty, 1990). The AHP method directs how to determine the priority of a set of alternatives and relative importance of attributes in a multiple criteria decision making problem. The AHP has been recommended as a useful decision-making approach (Easley et al., 2000).

In our study, we used the AHP since the BSC performance measures have hierarchic structure. Following the AHP procedure, first, six questions are asked for pair-wise comparing of the BSC perspectives (Business value, operation excellence, customer value, management and maintenance, web site interface, learning and innovation). Next, questions are asked to compare pairwise performance measures under each perspective (Saaty, 1985). It is essential to check the consistency ratio (CR) since the CR is larger than 0.1 is normally considered to be unacceptable.

Professional commercial software, Expert Choice, developed by Expert Choice, Inc. (2000), simplifies the implementation of the AHP's steps and automates many of its computations. The relative weights and the CR for each BSC performance measure were then calculated using this software.

We surveyed 40 employees and experts to acquire the relative weight of each performance measure. The CR is an important validating parameter in the AHP. Because the CR was larger than 0.1 for 12 points of the survey data, these 12 observations were not considered when calculating the relative weights. As [Appendix 1] show, the average $w_i$ is produced based on Equation 1.

$$w_i = \frac{\sum_{j=1}^{22} r_j}{22} \ldots (1)$$

$r_j$: The relative weight of j-th respondent
4.2. Determine type

Harrington first proposed a simple form of the desirability function. Derringer and Suich extended Harrington’s approach by suggesting a more systematic transformation scheme. To use the desirability function for normalizing performance measures based on their characteristics, the types of the performance measures should be determined according to the objective type.

For an objective to be maximized, which is called a larger-the-better (LTB)-type objective, the desirability function is defined by Equation 2. A smaller-the-better (STB)-type objective can be easily transformed based on Equation 3. Another type of objective is called the nominal-the-best (NTB) type. Unlike an LTB or STB-type, the bet value of an NTB type objective exist in the middle of its range. The desirability function for an NTB-type objective can be defined by Equation 4 (Jeong & Kim, 2005).

As [Appendix 1] shows, we determined a type of the performance measure in accordance with their objective type: LTB, STB and NTB.

4.3. Extract $Y_i, Y_i^{\min}, Y_i^{\max}$ & $C_i$

To acquire the real value, the minimum acceptable value, and the highest value of each performance measure, a data source such as a data base, secondary reports, a survey or an interview should be investigated. The minimum value and the highest value are acquired by a decision maker’s estimation. In addition to these values, if the type of the performance measure is an NTB, the most desirable value is obtained based on judgments of decision maker. [Appendix 1] represents value of each performance measure at time periods. As [Appendix 1] shows, the units and the scale of the performance measure differ entirely due to their various characteristics.

4.4. Decide r, s & t

The factors r, s, and t describe the shape of the desirability function. The selection of a suitable value of r offers the user flexibility in the definition of desirability function (Bourguignon and Massart, 1995). It may be reasoned that all times less than the highest value make the measure much less desirable and this would lead to a curve such as that obtained with $r = 3$. On the other hand, it might be reasoned that anything higher than lower acceptable value becomes rapidly more desirable and this would then require a desirability function such as that with $r = 0.3$. It is up to the user to decide. That is, the values of the factor r, s, and t are decided by the user and experts.

Based on the survey of 5 experts, we determined r, s and t, and the type of the BSC performance measure. As [Table2] shows, we derived the desirability value by using Equations (2), (3) and (4).

[Figure 4] Graph of transformation for various value of r, s, and t (Derringer and Suich, 1980)
5. Calculation phase

The desirability function involves transformation of each estimated response variable \( y_i \) to a desirability value \( d_i \), between \( d_i = 0 \), for a completely undesirably value, to \( d_i = 1 \) for a fully desired response, above which further improvements would have no importance (Derringer and Suich, 1980). The desirability value denotes a normalized parameter representing the distance between the estimated response and its target in units of the maximum allowable deviation. The bounds on a response \( (y_i^{\min} \) and \( y_i^{\max} \)) should be specified in advance according to the specification limits of the product or process, or the subjective judgment of the decision makers. The overall desirability \( D \), another value between 0 and 1, is obtained aggregating the individual desirability value.

The desirability function has been proven to provide a reasonable and flexible representation of human perception (Kirkwood and Sarin, 1980; Moskowitz and Kim, 1993) and is analytically convenient (Kim and Lin, 2000). And this makes it possible to combine result obtained for properties measured on different scale.

5.1. Construct the desirability value

The desirability value of each performance measure can be acquired based on Equation (2), (3) and (4). [Table 1] shows that these values vary between 0 and 1. If the value of performance measure \( (y_i) \) is equal to, or below, the lowest possible limit set for that criterion, then \( d_i = 0 \). If \( y_i \) is higher than, or equal to, the highest possible limit set for that criterion, then \( d_i = 1 \). Here 0 indicates a completely unsatisfactory result, whereas 1 indicates that the required level of response has been reached.

There are three types of transformations possible, LTB, STB and NTB. The NTB and STB transformation (Equation (2) and (3)) are applied to the cases where the target of the performance measure is either the minimum value or the maximum value. In addition to these transformations, the NTB transformation is applied to the cases where the target of the performance measure is nominal.

\[
d_i = \begin{cases} 
0 & \text{if } (Y_i \leq Y_i^{\min}) \\
\left(\frac{Y_i^{\max} - Y_i}{Y_i^{\max} - Y_i^{\min}}\right)^r & \text{if } (Y_i^{\min} < Y_i < Y_i^{\max}) \\
1 & \text{if } (Y_i \geq Y_i^{\max}) 
\end{cases} \quad \ldots (1)
\]

\[
d_i = \begin{cases} 
0 & \text{if } (Y_i \leq Y_i^{\max}) \\
\left(\frac{Y_i^{\min} - Y_i}{Y_i^{\min} - Y_i^{\max}}\right)^r & \text{if } (Y_i^{\min} < Y_i < Y_i^{\max}) \\
1 & \text{if } (Y_i \leq Y_i^{\min}) 
\end{cases} \quad \ldots (2)
\]

\[
d_i = \begin{cases} 
\left(\frac{Y_i - Y_i^{\min}}{C_i - Y_i^{\min}}\right)^r & \text{if } (Y_i^{\min} \leq Y_i \leq C_i) \\
\left(\frac{C_i - Y_i}{C_i - Y_i^{\max}}\right)^r & \text{if } (C_i < Y_i \leq Y_i^{\max}) \\
0 & \text{if } (Y_i < Y_i^{\min}) \text{ or } (Y_i > Y_i^{\max}) 
\end{cases} \quad \ldots (3)
\]
\( d_i \): The desirability value
\( y_i \): The real value of \( i \)th performance measure
\( y_{i\min} \): The minimum acceptable value of \( y_i \)
\( y_{i\max} \): The highest value of \( y_i \)
\( c_i \): The most desirable value of \( y_i \)
\( r, s, t \): Variables for determining relationship between \( y_i \) and desirability value
(Derringer and Suich, 1980)

[Table 1] shows the calculation results of the desirability function of each performance measure. For example, the transformation of USABILITY (performance measure) was performed according to Equation (2). The desirability function was constructed using the data from [Appendix 1].

\[
0.18 = \left( \frac{10 - 7.1}{10 - 6} \right)^{1.7}
\]

The minimum acceptance value is 6; the highest value is 10; the real value is 7.1. The variable for determining relationship between the performance measures and the desirability value is 1.7.

[Table 1] Desirability value of the performance measure

<table>
<thead>
<tr>
<th>Performance measure</th>
<th>Desirability value</th>
<th>Performance measure</th>
<th>Desirability value</th>
</tr>
</thead>
<tbody>
<tr>
<td># of employee</td>
<td>0.707106781</td>
<td>Revisit possibility</td>
<td>0.039751648</td>
</tr>
<tr>
<td>Asset</td>
<td>0.632288595</td>
<td>Total cost for managing the web site</td>
<td>0.992387564</td>
</tr>
<tr>
<td>Net Sales</td>
<td>0.104100534</td>
<td>Frequency of contents update</td>
<td>0.577350269</td>
</tr>
<tr>
<td>Ordinary Profit</td>
<td>0.000742447</td>
<td>Total Cost for web site promotion</td>
<td>0.378929142</td>
</tr>
<tr>
<td>The % of appropriate response to Customer inquiry</td>
<td>1</td>
<td># of specific events for promotion</td>
<td>0.037037037</td>
</tr>
<tr>
<td>Avg. Delivery time after order fulfillment</td>
<td>0.64</td>
<td>Security Level</td>
<td>0.07776</td>
</tr>
<tr>
<td>Response time to customer inquiry</td>
<td>1</td>
<td>Usability</td>
<td>0.11139497</td>
</tr>
<tr>
<td># of response channel to customer inquiry</td>
<td>0.333333333</td>
<td>Attractiveness</td>
<td>0.181660888</td>
</tr>
<tr>
<td>The total # of members</td>
<td>0.00983965</td>
<td>Navigation Efficiency</td>
<td>0.188735308</td>
</tr>
<tr>
<td>% of transaction conducted by members</td>
<td>0.068041382</td>
<td>Consistency of site structure</td>
<td>0.449775743</td>
</tr>
<tr>
<td>Avg. page views per day</td>
<td>0.19245009</td>
<td># of web management staffs</td>
<td>0.447213595</td>
</tr>
<tr>
<td>Avg. Visit per day</td>
<td>0.219280978</td>
<td>Technological capacity</td>
<td>0.577350269</td>
</tr>
<tr>
<td>Product diversity</td>
<td>0.625</td>
<td>Frequency of hardware upgrade</td>
<td>0.447213595</td>
</tr>
</tbody>
</table>
5.2. Derive the total score

The overall desirability function $D$ is defined as the weighted geometric average of $n$ individual desirability functions. Harrington (1965) proposed the use of a geometric mean to aggregate the individual $d_i$ value. Derringer (1994) also proposed a weighted geometric means, where $W_i$ are the relative weights among the performance measure, $i = 1, 2, \ldots, k.$

$$D = \left( d_1^{w_1} \times d_2^{w_2} \times \ldots \times d_k^{w_k} \right)^{\frac{1}{\sum W_i}} \quad (4)$$

$D$: The total score

$W_i$: Relative weight of $y_i$

If one of the properties has an unacceptable value (that is, if $d = 0$), the overall product will also be unacceptable, regardless of the value of the remaining properties. On the other hand, if all the properties are acceptable, the value of $D$ will fall in the interval $[0, 1]$ and will increase with increasing desirability values.

The overall desirability function value is the total score of company M. The values of the desirability function, given in Equation (3), were combined into the single total score using Equation (4). For the year 2002, the total score turned out to be 0.9342. However, as the company envisioned the core problems and made efforts to raise their competitive advantage, the total score increased. So, as of 2003, the total score of company M turned out to be 0.9808.

6. Decision making phase

The outcome of the collection phase, as explained previously, can benefit a company in a strategy planning process, as well as, can set up strategy for each performance measure, and provide beneficial information in term of grasping a whole picture of the organization. Also, by analyzing the normalized value, and the weight of each performance measure based on the importance-score diagram, organization can recognize and classify an important or less important division parts to set up a proper strategic plan for improving competitive advantage. Using the importance-score diagram, decision makers can derive the critical performance measure to increase the total score, which in its turn, reflects full organizational accountability.

6.1. Analyze the total score of time periods

Measuring the total score is useful for evaluating effectiveness of a company strategy or analyzing the current situation of the company. At a corporate or division level, this score allows for assessment of the strategy beyond the immediate and intermediate outputs. The total score provide a mechanism for a company to assess the impacts of its strategy on its products, services, processes, and its clients. Furthermore, by comparing the total score at time periods, a company can estimate the achievement level of its strategy. The result of the total score analysis can benefit the company in its strategy planning for improving core parts that influence competitive advantage, and provide beneficial information in terms of grasping a whole picture of current situation of the company. In particular, a relatively decreased value of the total score, or the incremental ratio of the total score is decreased between time periods.
indicates the weakening in terms of competitive advantage. [Figure 5] shows the change of the total score over the time periods.

![Figure 5](image)

By comparing the desirability values over the time periods, it is possible to determine critical performance measures which cause the decrease of the total score. Furthermore, by comparing the total scores of benchmarked companies, we can find the state of a company in the market. As [Figure 5] shows, company M experienced difficulties in the second quarter of 2002, which caused the decrease of the total score, as opposed to company A whose total score grew steadily. After 2002, the situation in company M had improved for the management of the company adopted the methodology proposed in this study. As a result, the company innovated their performance measurement system to identify their problems to achieve competitive advantage.

### 6.2. Analyze the importance-score diagram

Introduced by Martilla et al., in 2004, the importance-score analysis is employed by all best practice companies as the primary tool for identifying improvement opportunities (Chu & Choi, 2000). In short, the importance-score diagram maps out the performance measures according to their normalized score and executive perceptions of importance. The results of the analysis of the importance-score diagram can suggest certain improvement opportunities. The importance-score diagram is shown in [Figure 6].

The performance measures that are important to executive’s decisions but on which the company does not perform well are classified into Quadrant 2, ‘Concentrate here’. A company needs to focus on improving its performance on these performance measures.

Therefore, we suggested the performance measures in Quadrant 2 to the executives for identifying the core parts of the company to be improved. The importance-score diagram was designed based on $d_i$ & $w_i$. The performance measure in Quadrant 2 of the importance-score diagram provided an attractive snapshot of how well the company meets strategic achievements and at the same time, offered guidelines for the company future limited
resource allocation decisions. The importance-score diagram of company M is shown in [Figure 7].

<table>
<thead>
<tr>
<th>Importance</th>
<th>Quadrant 2</th>
<th>Quadrant 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Concentrate here</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>Low</td>
<td>Low priority</td>
<td>Possible overkill</td>
</tr>
</tbody>
</table>

[Figure 6] The importance-score diagram

[Figure 7] The importance-score diagram in 2002

The performance measures in quadrant 2 as follows. Based upon the extracted performance measures, we developed strategies for improvement.

- Total number of members
- Number of specific events
- Ordinary profit
- Revisit possibility
- Security level
- % of transaction conducted
- Usability
- Attractiveness
- Average number of visits per day
- Average number of viewed pages per day
- Navigation efficiency
6.3. Establish strategy
To improve the performance measures suggested in [Figure 7], company M planned the next these 4 possible strategies.

- **Strategy to attract customers**
  - Strategic alignment with other portal sites
  - Providing free flash animated greeting card if customers join membership
  - Producing a humor flash animation
  - Gaining customer information through strategic alignment

- **Strategy to provide better service for those customers who have purchasing experience**
  - Providing discount coupons if customers purchase their products
  - Giving discount coupons to members per a month
  - A high number of sales

- **Strategy to improve usability**
  - Employing usability experts for Web sites
  - Increasing page-loading speed
  - Spending more resources and employing more steps to develop new unique services

- **Strategy to increase security level**
  - Installing Web encryption product that offers real-time 128-bit encryption of the data transmitted between web servers and web browsers

As it was calculated in the preceding section, the total score, as of 2002, was 0.9342, while the total score in 2003 turned out to be higher since the company adopted our methodology. The increase of the total score and the financial measure proved the usefulness of our methodology. In other words, our methodology provided a good basis for improving the Web site of company M for competitive advantage and guidelines for solving the company’s core problems.

7. Conclusions
The BSC approach has been used as a tool for suggesting measures that can evaluate the performance of a company by considering both financial & non-financial perspectives. The BSC develops qualitative and quantitative measures considering the discrepancy of the measure units. Although the BSC approach identifies the achievement rate of each measure, it does not provide the information on the overall strategic achievements of a company. Consequently, it is difficult to evaluate the whole strategic performance and find the core obstacles. The current BSC method does not provide techniques to formally define, verify, implement, consolidate and analyze the performance measures.

In this paper, we proposed methodology for evaluating the effectiveness of a company based on the performance measures. The total score provided the milestone for the whole organization, and the global strategic target. The model proposed in this paper would provide executives with the single total score as well as the corresponding information model for interpreting the information provided. The availability of the total score could, in turn, lead to the establishment of standard sets of consolidated measures and to the institutionalization of internal–external benchmarking practices. The developed model provides the acquisition of the normalized value to reflect the characteristics of each performance measure and derivation of the total score, based on the desirability function. The model consists of the following
three phases: collection phase, calculation phase and decision making phase. The suggested model was illustrated through a case study. The results of the case study justified the usefulness of our model.

Using the proposed modes, a company can set up more efficient strategies through proposed model. However, this model is somewhat subjective, as long as the levels of $y_{j}^{\min}$, $y_{j}^{\max}$, $r$, $s$ & $t$ are set by decision makers and experts subjectively. Therefore, the future work can be concentrated on the establishing more objective methods for choosing the levels of $y_{j}^{\min}$, $y_{j}^{\max}$, $r$, $s$ & $t$.

References
## Data of Company M

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Performance measure</th>
<th>Unit</th>
<th>$W_i$</th>
<th>$Y_i$ (2002)</th>
<th>$Y_i$ (2003)</th>
<th>Type</th>
<th>$Y_{i\min}$</th>
<th>$Y_{i\max}$</th>
<th>$C_i$</th>
<th>$r$, $s$, &amp; $t$</th>
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<td># of employee</td>
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<td>$s=0.5$, $t=3$</td>
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<td>The % of appropriate response to Customer inquiry</td>
<td>%</td>
<td>0.0152</td>
<td>100.0</td>
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