

BALANCED SCORECARD EVALUATION MODEL THAT INCLUDES ELEMENTS OF ENVIRONMENTAL MANAGEMENT SYSTEM USING AHP MODEL

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Abstract: The research is oriented on improvement of environmental management system (EMS) using BSC (Balanced Scorecard) model that presents strategic model of measurements and improvement of organisational performance. The research will present approach of objectives and environmental management metrics involvement (proposed by literature review) in conventional BSC in "Ad Barska plovidba" organisation. Further we will test creation of ECO-BSC model based on business activities of non-profit organisations in order to improve environmental management system in parallel with other systems of management. Using this approach we may obtain 4 models of BSC that includes elements of environmental management system for AD "Barska plovidba". Taking into account that implementation and evaluation need long period of time in AD "Barska plovidba", the final choice will be based on 14598 (Information technology — Software product evaluation) and ISO 9126 (Software engineering – Product quality) using AHP method. Those standards are usually used for evaluation of quality software product and computer programs that serve in organisation as support and factors for development. So, AHP model will be based on evolution criteria based on suggestion of ISO 9126 standards and types of evaluation from two evaluation teams. Members of team & will be experts in BSC and environmental management system that are not employed in AD "Barska Plovidba" organisation. The members of team 2 will be managers of AD "Barska Plovidba" organisation (including managers from environmental department). Merging results based on previously created two AHP models, one can obtain the most appropriate BSC that includes elements of environmental management system. The chosen model will present at the same time suggestion for approach choice including ecological metrics in conventional BSC model for firm that has at least one ECO strategic orientation.

Keywords: BSC, Enviromental Management system Eko BSC, AHP

1. INTRODUCTION

The literature oriented at the research of improvement of environmental performance through the implementation of ISO 14001 standards, has a rather controversial views. While the researches [1, 2, and 3] prove that the ISO 14001 standard promotes the environmental performance of the organisations, the researches [4, 5, 6, and 7] offer completely different evidence and point to the possibility of their aggravation. It is, thus, suggested that the future ISO 14001 certification must include the elements of management through performance and some measures which provide a continuous harmonising with the requirements of the standards. In compliance with those assimilations of ISO 14001, not only in the existing management system, but in the everyday activities of the employees, would represent a key improvement in this direction, with respect for the specific qualities of the existing practice.

Therefore, the implementation of the environmental objectives in the strategy of the

organisation would be of great importance, while the Balanced Scorecard (BSC) as a strategic system of management through performance may represent a rather good choice. Balanced scorecard represents a system of management through performance which tends to transmit the strategy of the organisation to all employees transforming it to objectives and measures at all levels within 4 recommended action directions (perspectives: finance, customers, internal processes, learning and growth). However, since the structure of the BSC model depends on the type and organisation's orientation, it is important to consider 2 BSC concepts from the aspect of defining of the strategy:

- The concept of for-profit and
- The concept of non-profit organisations

For-profit organisations are primarily aimed at financial gain, which means that the objectives of all perspectives (directions of strategic activities) are aimed at financial gain of the organisation, while the non-profit organisations base their work on a designed budget for the accomplishment of the set strategic objectives.

The introduction of the objectives and measures of environmental management system, which directly correlate with financial gain into a profit-oriented BSC model, offers the opportunity to for-profit organisations to treat the environmental aspect as peripheral. Despite that, this approach is the most advocated in the organisations.

On the other hand, with BSC model in non-profit organisations, the relation to this issue would depend mostly on the available budget. The priority here is the satisfaction of the customers/stakeholders, so linking the environmental performances with this perspective would be much more effective for the promotion of environmental performance, than linking it with the financial indicators in for-profit organisations.

In accordance with the previous analysis in this work, the analysis of approach to assimilation of objectives and measures of environmental management system into the Balanced Scorecard model is presented, and the proposals for promotion of environmental management system according to the model of joint-stock company "Barska plovidba" are put forward.

2. EKO BSC CREATED BASED ON A NON-PROFIT ORGANISATION MODEL

According to [8], the environmental performances may be integrated in BSC in three ways:

1. Integrating the environmental performances into the four existing BSC model perspectives
2. Creating new perspectives which encompass these elements
3. Creating special environmental scorecard

In practice, the first approach of including the environmental performances into conventional BSC model (four perspectives: finance, users, internal processes, learning and development) is the most present, and less by adding the perspective which includes these objectives, because for the majority of organisations these issues are not relevant in terms of strategy. Thus, there are many supporters of the following concept: it adding new perspective depends on strategic importance of these elements [8, 9, 10, 11, 12, 13, 14, and 15].

However, these two concepts have always created a justified fear for the EMS managers that because of the small number of objectives within the BSC model, which has the need to replace other management systems of the organisation, this issues will be more and more neglected.

On the other hand, creating a special, so-called ECO BSC oriented only on environmental management system would completely include all of its elements through the overall management system. A justification for the rare usage of this model in practice is the

creation of a parallel system in relation to the conventional BSC. But, what do the parallel systems mean? Isn't the EMS to ISO 14001, or any other management system which is not entirely included in BSC its parallel system?

In compliance with that, there is a **hypothesis** that:

The BSC models with a specially created EKO BSC, oriented only at the system of management through environmental protection, make a system which promotes environmental performance.

Through good connection of ECO BSC with the conventional BSC model, desirable results regarding effective and efficient environmental protection at the level of the organisation could be achieved.

The scientific works were not explicitly oriented at effectiveness and efficacy of creation of such specially designed scorecards in the organisations, nor was the manner of their connection with the conventional scorecard analysed. Only rare sources of literature illustrated some examples from practice of special EKO BSC maps, within for-profit organisations [13, 14, 16, and 17].

In the joint-stock company "Barska plovidba", the BSC model intended to the overall business was created, and it only slightly included the elements of environmental management system, for the joint-stock company "Barska plovidba" for boats has an established system of secure management "Safety Management System (SMS)", based on the IMS code, and enacted by the IMO as an obligatory regulation for all nautical companies operating in international maritime transport.

Each BSC model is based on a well chosen list of objectives and measures reflecting the aspects of organisation's activities.

Thus, for the needs of construction of ECO BSC model through application of AHP method of deciding through many criteria, a list of objectives and measures was primarily formulated in this work, and then, based on group decision-making process of the most competent member of the joint-stock company "Barska plovidba", their evaluation was performed. In this manner, they reached the final list of importance of metric of environment management system for its inclusion in ECO BSC model.

When the list of objectives and measures with weighted coefficient for ECO BSC at the corporation level was created, its creation and cascade lowering to lower levels in organisation was conducted. In Figure 1, there is an ECO BSC map for the corporation model of the joint-stock company "Barska plovidba". The ECO BSC model, illustrated in Figure 1, enclosed all the ecological objectives and measures at the corporation level of the joint-stock company "Barska plovidba", which makes the whole system of management through environmental protection covered by five perspectives. The model is based on the principle of functioning of the non-profit organisations, thus with a designed budget perspective, which makes the objectives of this

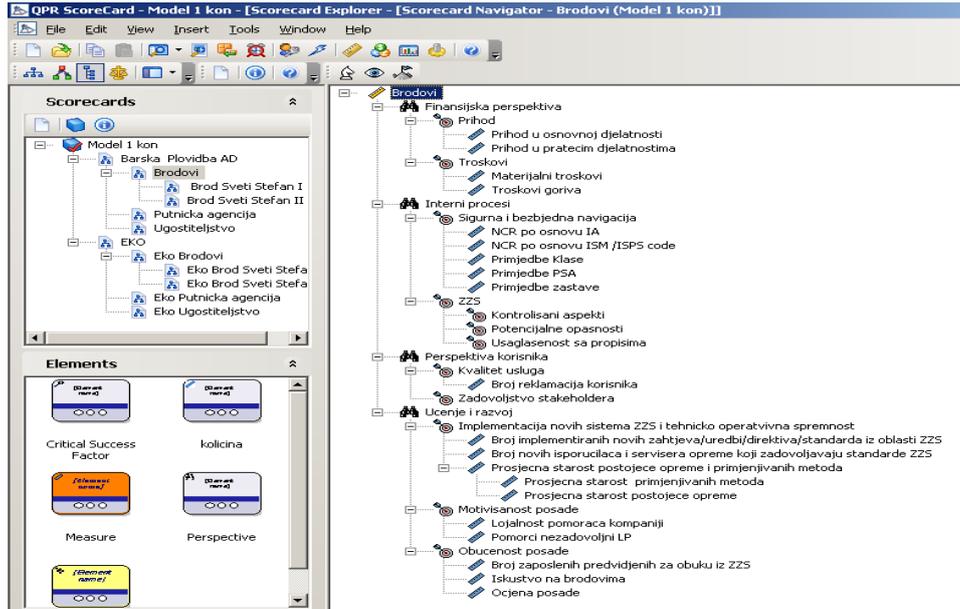


Figure 2. Model 1 connection of conventional and ECO BSC

Connecting these two models to make one is practical and necessary for two reasons:

1. Top management has the insight in the results of both conventional and ECO BSC model;
2. Easier calculation of the value of objectives and measures from the higher levels of conventional scorecard, via importing the values from ECO BSC.

The greatest importance in these operations belongs to the process of connecting these two models, upon which the sustainability of such proposal depends.

There are 4 possible approaches (models) illustrated in the work.

In Figure 2, there is the first approach of their connection by including the environmental management system metric into the existing perspectives of the conventional BSC model, which creates Model 1.

In the 2nd model of connecting the ECO and conventional BSC model, a special, so-called ECO perspective was created: it encloses the key objectives of EKO BSC implemented in the conventional BSC model, as it is illustrated in Figure 3.

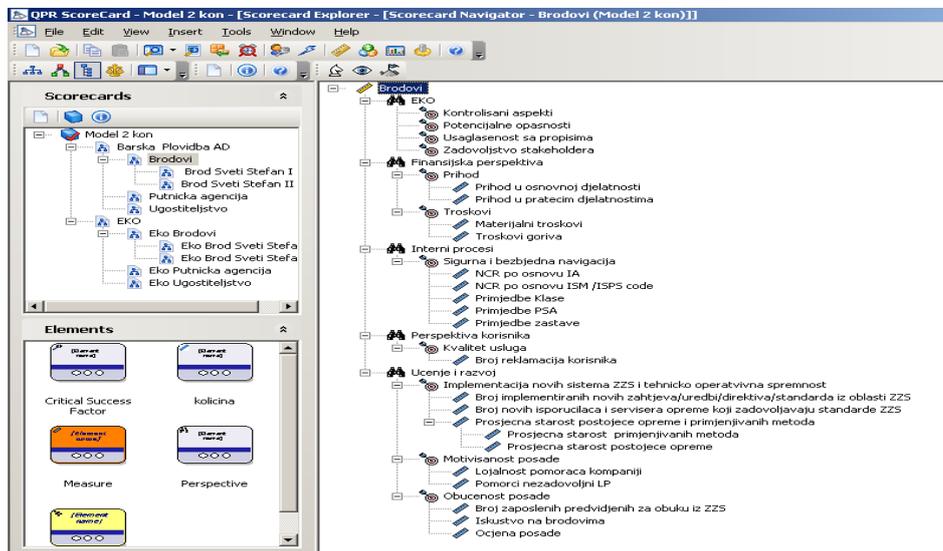


Figure 3. View of conventional BSC connected with ECO BSC created with new perspective (Model 2)

In order to fully respect the principle which was recommended in the literature, in the sense of including the elements of the environmental management system in the conventional BSC model, apart from the two previously designed models, two more will be created:

1. Model 3, which corresponds to the approach of inclusion of the elements of environmental management system in the existing BSC – this approach corresponds to model 1, but without the supporting ECO BSC;
2. Model 4, which corresponds to the approach of inclusion of the elements of environmental management system in the newly created so-called ECO perspective – this approach corresponds to model 2, but without the supporting ECO BSC.

Four possible manners of their interconnection were created through the previous analysis of the approach of including ecological metrics based on literary sources and additional examinations in the real working environment.

The choice of the most favourable implementation model in the joint-stock company will be achieved on the basis of expert assessments.

4. ASSESSING MODELS FOR IMPROVEMENT ENVIRONMENTAL MANAGEMENT SYSTEM

The process of assessing the model is not feasible in their real working conditions, because a rather long period for the implementation of each model is needed, and a rather long period for the evaluation of their values in practice, and thus, the assessment of the models will be conducted from theoretical and empirical aspects of the experts from all areas of functioning. Namely, in the assessment of the models, the available standards for these issues will be analysed, and through their implementation in certain areas, the usable value of each model will be defined, according to the literature considered.

The reference standard for the assessment of BSC models created in this work is certainly the ISO IEC 9126 – Software engineering-Product quality-Quality Model, which considers the assessment of software products through the assessment of internal and external quality of the model and the quality of the model which is in use.

The evaluation of four BSC models will be conducted only by the implementation of internal and external quality model, i.e. based on six criteria and their 27 subcriteria, while the evaluation of the “software quality in use” is provided for further researches after the implementation of the chosen BSC model. The ISO 9126-1 standard enables the exception of certain criteria and subcriteria in the evaluation

process, with the justified explanations. Nevertheless, in order to define the meaning of the subcriteria more precisely, it is necessary to apply the technical standards ISO IEC 9126-1 and ISO IEC 9126-3, which recommend the relevant external and internal measures and explain the importance and meaning of each criterion and subcriterion.

The model evaluation process will be conducted in two parallel sessions, by two teams:

1. Team 1, whose members will be the experts from the areas of environmental management system and BSC, but who are not employed in the joint-stock company “Barska plovdba”;
2. Team 2, whose members will be competent personnel from the top management of the joint-stock company “Barska plovdba” (including the EMS manager).

Team 1 conducts the evaluation of quality criteria (total of 6) and subcriteria (27), based on the internal measures with a view to evaluating the capabilities of the software product, to satisfy the requirements and needs of the organisation from the aspect of strategic management of the organisation and environmental management system.

Team 2 conducts the evaluation of quality criteria (total of 6) and subcriteria (27), based on the external measures with a view to evaluating the degree in which the software product can, in real conditions, satisfy the requirements and needs of the organisation from the aspect of strategic management of the organisation and environmental management system.

Apart from the series of ISO 9126 standards, the ISO organisation has issued a series of ISO 14598 standard – Software product evaluation more as the instruction for conducting the evaluation process. The process of model evaluation described with the ISO 14598 standard is compatible with MCDM decision-making methods, in which the evaluation of elements from one level is performed in relation to the element of a higher level.

The AHP model has, to this purpose, used the MCDM method most often [18, 19, 20, 21], and it will be used for the needs of this evaluation, too. The team members have performed the evaluation on the basis of all 6 criteria and 27 subcriteria (ISO 9126-1), so it can be said that those are the AHP models of a group synthesis with complete information. The evaluation was conducted according to the principle of individual assessment of each team member, after which the integration of the evaluations was conducted. In that manner, group results of evaluations for team 1 and team 2 were achieved.

This work will not provide separate evaluations of each team members, but only the group models achieved through the synthesis of the evaluations of team members. The results achieved by the evaluation of team 1 (experts who are not employed in the joint-

stock company “Barska plovidba”) are illustrated in the Figure 4.

The results of model evaluation done by team 1 show high consistency of the solution. Namely, the non-consistency of 0.02 is very good, bearing in mind that its maximum allowed value is 0.1. The solution of the team 1 points to the best ranked model 2, which is the model which, apart from specially created ECO BSC model, also includes an additionally created ECO perspective in the conventional BSC model. The model 4 is the second-ranking; it does not include specially

created ECO BSC model, but it still has an additional ECO perspective within its conventional BSC model. Thus, it is obvious that team 1 has not utterly favour the creation of the special ECO BSC model, because it gave advantage to model 4 in respect to model 1, which has the ECO BSC, but it still gave significant advantage to the model which encloses the specially created ECO BSC model (model 1) in respect to the model which introduces only some of the ECO objectives and measures in the existing perspectives of the conventional BSC model (model 3).

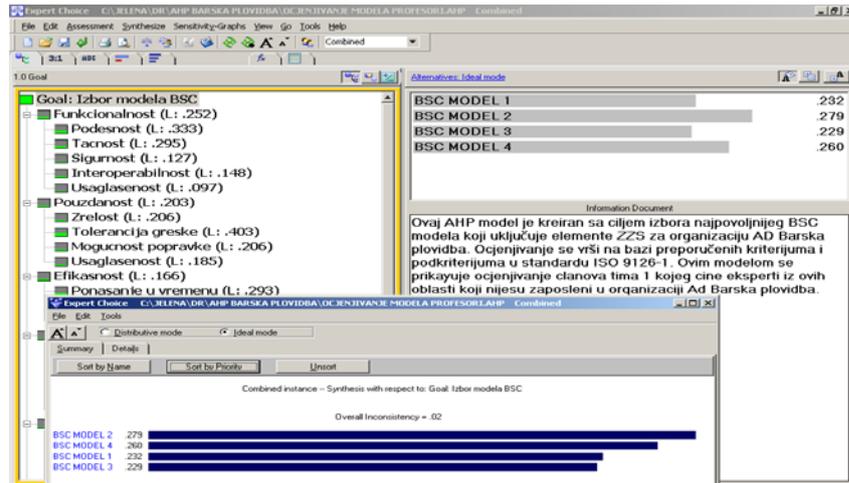


Figure 4. Results of evaluation of Team 1 based on grouped AHP model

The results gained through the evaluation of the BSC model of team 2 (managers from the

joint-stock company “Barska plovidba”) are illustrated in the Figure 5

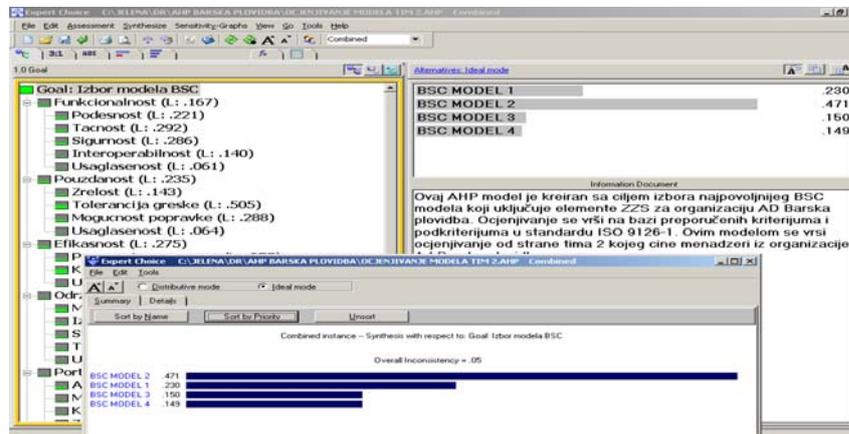


Figure 5. Results of evaluation of team 2 based on grouped AHP model

The results of the evaluation conducted by team 2 also point to a very good solution consistency (0.05). The best ranked model is also model 2, as with the team

1 evaluations. It is also illustrated here that the model 2 has significant advantage in respect to other models. It is also obvious that the team 2 favoured the solutions

considering the creation of special ECO BSC model, thus models 1 and 2, while they estimated models 3 and 4 with almost same evaluations and severely lower than those given to the models which have a specially

created ECO BSC. With a view to gaining a final rank-list of the recommended models, another AHP model was created (Figure 6), within which the results from team 1 and team 2 evaluations were incorporated.

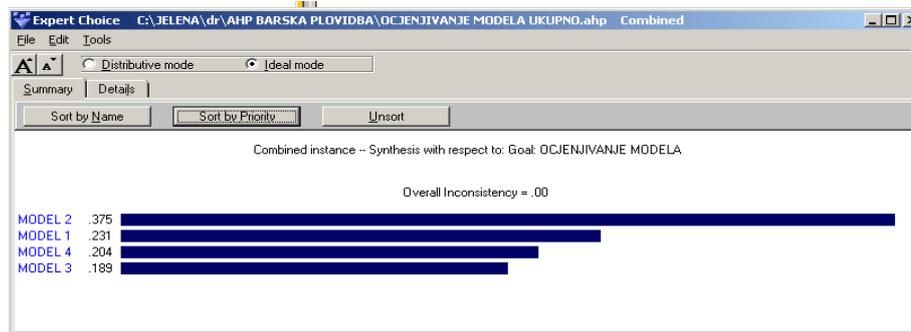


Figure 6. Results of assessing models

Through the analysis provided by AHP model of evaluation, illustrated in Figure 6, it can be noted that there is a certain pattern of ranking the models in relation to the volume they are oriented on the environmental management system. Namely, the BSC models which encompass the specially created ECO BSC models (models 1 and 2), through which they most broadly included the area of environmental management system in the organisation, were given the highest estimates; model 2, which in its BSC model has also the ECO perspective, through which the connecting with ECO BSC model is performed, was the best ranked model. The third most significant BSC model is model 4, which, although it does not possess a specially created ECO BSC model, has the fifth perspective in the conventional model, the so-called ECO, by which it is more oriented at the environmental management system than the last-ranked model, model 3, which includes only some of the objectives and measures within the four existing perspectives of the conventional model. The model which gained the lowest possible rank was model 3, which is the most present one in the practice, but the least oriented at the environmental management system. The obtained results confirm the hypothesis from the beginning of this work, and which refers to the fact that the BSC models with the specially created ECO BSC model, oriented only at the system of management through environmental management system, make the system which promotes the environmental performance.

The BSC model chosen via this approach and encompassing the elements of environmental management system, not only represents the most favourable solution for the organisation observed, but at the same time it represents a recommendation for the election of approaches of inclusion of the elements of environmental management system into the conventional BSC model, to all the organisations which have at least one of the ECO-oriented objectives.

5. CONCLUSION

In this work, we have presented four models of BSC including the elements of environmental management system for the joint-stock company "Barska plovdba". Models 1 and 2 were based on an approach which protects the creation of the so-called ECO BSC, and it's linking to the conventional BSC model was done in two ways, in accordance with the literary recommendations. Models 3 and 4 do not comprise the specially created BSC model oriented at environmental management system, but this area is covered within the existing perspectives and/or by creating an additional perspective in the conventional BSC. With a view to evaluating the created models more objectively and choosing the most favourable one to implement in the joint-stock company "Barska plovdba", the AHP model of a group multi-criteria decision-making was created, with the criteria of evaluations defined by the ISO 9126-1 standard.

In this manner, model 2 was presented as the best ranking model which, apart from the specially created ECO BSC model covering completely the area of environmental management system, also has a newly created, so-called ECO perspective in the conventional BSC model, which draws the key ECO metric from the ECO BSC model. This kind of model choice reached from a concrete real problem in a for-profit organisation which is still strategically oriented to the environmental management system certainly represents the recommendation to all organisations committed to the environmental management system, but which are in the dilemma when choosing the BSC approach including the EMS elements. This is the approach which was not justified in the literature because of the possibility of creating parallel systems and which has, in this work, proven to be the most favourable solution for the improvement of environmental performance in the real working system.

Namely, numerous literature analysed, dealing with the issues of Balanced Scorecard was not focused on the effectiveness and efficacy of the models which include the specially created ECO BSC models, so this work gives a contribution of its own kind, in that direction.

This work pointed at very good opportunities of linking the ECO and conventional BSC model, which would help avoid the possibility of creation of the parallel systems of management on one hand, and create all necessary conditions for the improvement of

environmental performance on the other. Nevertheless, after this model evaluation (based on 2 AHP models), there is only one final step, and it refers to the fact that after the implementation of the elected model in the joint-stock company "Barska plovidba", the evaluation of the quality of the model in use is performed, and in compliance with the ISO 9126-4 standard, as an additional approval of the justification of the elected approach.

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