



Introducing the Evaluation Tools for HSE Management System Performance Using Balanced Score Card Model

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ABSTRACT

Background: The performance of the HSE units has various dimensions leading to different performances. Thus, any industry should be capable of evaluating these systems. The aim of this study was to design a standard questionnaire in the field of performance evaluation of HSE management system employing Balanced Score Card model.

Methods: In this study we, first determined the criteria to be evaluated in the framework of Balanced Score Card model based on the objectives and strategies of HSE Management System and existing standards, and then designed questions on every criterion. We used content validity and Cronbach's Alpha to determine the reliability and validity of the questionnaire.

Results: The primary questionnaire was comprised of 126 questions some of which were omitted regarding the results obtained from the CVR and CVI values. We obtained the CVI average of environmental dimension to be 0.75 and its CVI average 0.71.

Conclusion: With respect to the results of the reliability and validity of this questionnaire, and its standardized design we can suggest using it for evaluation of HSE management system performance in organizations and industries with the mentioned system.

1. Introduction

The question of the performance evaluation has long challenged the researchers and scholars in different fields [1]. On the other hand, the performance evaluation is considered as the best method to obtain the required information for decision making in the organizations. Thus, there

will be a need for evaluation of the performance with respect to the ongoing activities within any organization in different time periods [2].

Generally, the performance evaluation system can be defined as the process of evaluation,

measurement and comparison of the degree and the method of acquiring the desired situation with criteria and attitude, a certain scope and covering area in specified time periods aiming at constant reviewing, amending and improving [3]. In other words, the performance evaluation is the measurement of the daily activities of the organization to specify the degree of obtaining the pre-determined objectives [4]. The importance of the performance evaluation depends on different factors including assigning an appropriate tie for this action, energy, human and financial resources, etc. The importance of evaluation results from the fact that it distinguishes the degree of deviation of individuals, organization's units, systems and ongoing processes from the objectives and the inherent aim of the organization [5]. The Balanced Score Card model is one of the modern models in the field of performance evaluation which has been introduced by Robert Kaplan and David Norton [6]. There are four viewpoints towards this model including growth and learning; financial customer; and internal processes [7]. This model is used for strategic planning, strategic management as well as the performance evaluation. The presentation of a comprehensive as well as a specialized attitude from the organization performance or the unit to be evaluated is one of the most important characteristic of this model [1, 8]. The quality and a proper working output of HSE management systems is one of the main factors in the accomplishment of the objectives of the organization in the HSE related fields [9]. If the HSE unit is considered as an independent unit in providing a business or services, it will require the performance evaluation for fulfilling its goals.

On the other hand, the HSE management system should be evaluated continually to improve the HSE management system's activity level [10, 11]. In fact, the HSE management system evaluation help managers move toward constant improvement by finding the deflection of system and implementing the corrective measures [12].

The methods applied so far are of passive kind and we can point to Frequency Rate – FR coefficient or Incidence Rate – IR, etc. Moreover,

the applied factors in these evaluations are not as effective as the desired ones [10, 13].

Therefore, it requires a comprehensive tool for performance evaluation of the present and past time in these units, so we used the Balanced Score Card model as a framework for the designed questionnaire.

2. Materials and Methods

This study was performed for tools designing.

First, the criteria in the framework of Balanced Score Card model based on the objectives and strategies of HSE Management System were defined using the studies carried out previously as well as using the existing standards in the field of Health, Safety and Environment (HSE). Then, some questions were devised regarding each of these criteria. As the Balanced Score Card model has the required flexibility to involve a subject as a separate layer and on the other hand as the safety is highly emphasized in the HSE systems' evaluations, the designed questionnaire studied the environmental dimension separately, so the questionnaires were distributed separately among ten individuals including the professors and scholars of whom seven persons held PhD in Environmental Health Engineering and a PhD in Environmental Engineering and the remaining two held MSc. in Environmental Engineering. The remainders of devised questionnaires were distributed among 9 experts in this field with different specialties (including one holder of PhD in environmental engineering, one individual holding PhD in environmental management majoring in HSE, one holding PhD in Occupational Health, four people as MSc in Occupational Health, one holding PhD in Health Management) in four other dimensions of Balanced Score Card model (growth, and learning, financial, customer and internal processes). Each questionnaire was in two forms (A&B). The first form included issues to study the questions in three levels of simplicity, clarity and relatedness.

The second form included issues to review the questions in the fields of "necessary", "useful but

unnecessary" and "unnecessary". Moreover, at the end of the designed questionnaire the scholars were asked to declare their comments for improvement of the questionnaire. In this study we used content validity, because the content validity has higher validity over face validity [14]. To study the validity and inner compatibility of the questionnaire, we used the content validity method and the Cronbach's Alpha.

2.1. Content validity Ratio (CVR)

The aim of studying this index was to determine the necessity and the importance of the questions of the questionnaire from the viewpoint of the panel members. The CVR index was computed through the following formula (Equation 1) for every question after interpretation of the acquired information from the filled questionnaires by the panel members [15]. The different CVRs are required with respect to the CVI table for acceptance of the question regarding the two scholar groups with different members [16]. As there were ten people as the panel members in the environmental dimension, based on the table the acceptable CVR members for these numbers was 0.62 and for the other nine people of the panel in the dimensions of the other designed questions the acceptable CVR was 0.78. In this stage the questions whose CVR values were less than the standard number were omitted.

2.2. Content Validity Index (CVI)

The purpose of this index was to define the clarity, simplicity and relatedness of the questions from the point of view of the panel members. The CVI was computed for each question after the interpretation of the form A using the following formula [17]. CVR equals: the total agreed scores for each question with the ranks 3 and 4 divided by the total answers .

After computation of this index, the questions with CVIs higher than 0.76 were distinguished as appropriate and used in the final questionnaire.

With respect to the views of most of the panel members in the designing of the new questions in a certain field, some questions were designed in the recommended fields in the main questionnaire

and because these questions were in on the frameworks of model's four dimensions of Balanced Score Card model, the nine members of the panel were asked to declare their views on the questions again. The indexes of CVI and CVR for new questions were computed. After assurance of the acceptable and standard nature of the content validity of the questionnaire, the inner (final) compatibility of the related tools was the next issue to be proceeded. For determining the final questionnaire we used the Cronbach's Alpha. That way the remaining questions were distributed among the twenty individuals of the employees of Zanjan zinc industry. The data was entered into the SPSS11.5 software, and the Cronbach's Alpha value analyzed after gathering the acquired information from this stage. These dimensions were analyzed separately to acquire the Cronbach's Alpha with respect to the four dimensions of the Balanced Score Card model as well as the added dimension of the environment.

One of the dimensions had the Alpha Coefficient lower than 0.7 which was distributed among other twenty employees of the zinc industry after alterations made into the questions as well as adding some more questions using the expert panel members. This time the Cronbach's Alpha were computed as being 0.8 which shows that the computed Cronbach's Alpha was more than 0.7, its finality will be proved. The value of Cronbach's Alpha for all and each questions were computed which was equivalent to 0.9

3. Results and Discussion

As described in the methods, the questionnaire comprises of five dimensions with the environmental dimension severally and the other four dimensions were also separately distributed among the members of experts' panel in different specialties. Each of the questionnaires had two forms of one and two, and the members of the panel were asked to answer them. Some questions were also added to the main questionnaire after considering the views of the panel members.

The CVR and CVI values were computed for each question, after the formulation of equation 1 in the Excel and Word software and entering the

data attained from the refereeing decisions of the panel group. Some questions (62 items) were omitted and three questions were also omitted after the computation of Cronbach's Alpha. Four questions were added to the questionnaire upon the recommendation of the panel members and one item among these questions was also omitted, and finally the questionnaire completed as a 64-item questionnaire.

The CVI average of the environmental dimension was set to be 0.75 and CVR average of it to be 0.71 with respect to the validity evaluation of the questionnaire in two different groups (environment and comprehensive questions).

There is not a complete and one single questionnaire to evaluate the performance of the HSE management system, which is why the majority of factories use the common checklists in this field and these checklists are variable with respect to the type of the industry or the production of a certain factory. In a study carried out by Shafaei, et al., in 2013 entitled "The Study of HSE Performance of Contractors" based on the key factors in the Petrochemical industries, although they used the checklist and questionnaire for evaluating the HSE performance, the checklist used in this study was peculiar for the petrochemical industries and it was also designed based on the seven principles of HSE management system and the parts concerning the environment were shown to be of less importance compared to other HSE system components [18].

In another study carried out by Naseri et al., in 2014 entitled "the HSE Management System Performance Evaluation based on the Balanced Score Card model (BSC)" in an active enterprise in the energy field, they proceeded to design the model of HSE management strategic performance evaluation in the form of the Balanced Score Card model using the standards and existing models in the fields related to the HSE management system. In this study they also did not use a standard questionnaire [19].

4. Conclusion

With respect to the previous studies carried out on performance evaluation in the field of HSE, the evaluation departments of these units were of less importance from the environmental perspective.

On the other hand, the Balanced Score Card model is also well-known in the field of performance evaluation for the experts of this arena. With respect to the superiority of the Balanced Score Card model regarding the concentration on the leading indexes in the performance evaluation and its rare usage in the safety fields, especially using the questionnaire, the necessity of devising a united and standard questionnaire in the country on the framework of this model is undeniable. Thus, we have provided a standard and single questionnaire in this study utilizing the proficiency of 19 individuals of the expert panel in different fields.

The devised questionnaire for evaluation of HSE management system performance based on the improved model of the Balanced Score Card is a proper and valid tool to determine the strengths and weaknesses of the management systems with acceptable validity and reliability. Therefore, the designed questionnaire can be used in independent centers with respect to the shortage of valid and reliable material in this field. With respect to the results obtained from the application of the designed questionnaire in one of the active companies in the field of manufacturing transformers and power disconnects, we can also suggest this designed questionnaire could obtained desired results in other industries. However, this will need further research.

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References

1. Ridwan R, Harun H, An Y, Fahmid IM. The Impact of the Balanced Scorecard on Corporate Performance: The Case of an Australian Public Sector Enterprise. *Int Bus Res.* 2013; 6(10): 103.
2. Kaplan RS, Norton DP. The Strategy-Focused Organization: How Balanced Scorecard Companies thrive in the New Business Environment. *Boston: Harvard Business School Press;* 2001.
3. Kaplan RS, Norton DP. The Balanced Scorecard: Measures that Drive Performance. *Boston: Harv Bus Sch Press;* 2005; 83(7): 172.
4. Ardekani SS, Morovati Sharifabadi A, Jalaly M, Eghbali Zarch M. Comprehensive Performance Evaluation Using FAHP-FVIKOR Approach Based on Balanced Scorecard (BSC): A Case of Yazd's Ceramic and Tile Industry. *Iran J Manag Stud.* 2013; 6(6): 81-104.
5. Ghanatghestani HM, Jafari D. Provide and Develop a Performance Evaluation Model Based on Process Management System (Case Study: Nouri (Borzouyeh) Petrochemical Company). *Cumhuriyet Sci J.* 2015; 36(4): 437-61.
6. Kaplan R, Norton D. The Balanced Scorecard-Measures That Drive Performance. *Harv Bus Rev.* 1992; 1(70).
7. Wang Y, Li Y, Jan C, Chang K. Evaluating firm Performance with Balanced Scorecard and Data Envelopment Analysis. *Wseas Trans Bus Econ.* 2013; 10: 24-39.
8. Zin NM, Sulaiman S, Ramli A, Nawawi A. Performance Measurement and Balanced Scorecard Implementation: Case Evidence of a Government-linked Company. *Procedia Econ Finance.* 2013; 7: 197-204.
9. Mohammad Fam I, Azadeh A, Jafari M, Kianfar A. The Introduction of a Fuzzy Expert System Based on Balanced Scorecard for Measuring the Effect of Health, Safety and Environment Management System on Organizations. *Sha J Sci Tech.* 2008; 53: 137-45.
10. Veley C, Ritchie N, Coats EA, Disatell J, Cook P. A New Method of Measuring Safety Performance will Soon Affect the Whole Industry. *Soc Pet Engineers.* 2004.
11. Wang Y, Tian M, Wang D, Zhao Q, Shan S, Lin S. Study on the HSE Management at Construction Site of Oil and Gas Processing Area. *Procedia Eng.* 2012; 45: 231-4.
12. Li W, Liang W, Zhang L, Tang Q. Performance Assessment System of Health, Safety and Environment Based on Experts' Weights and Fuzzy Comprehensive Evaluation. *J Loss Prev Process Ind.* 2015; 35: 95-103.
13. Toellner J. Improving Safety & Health Performance: Identifying & Measuring Leading Indicators. *Prof Saf.* 2001; 46(9): 42.
14. Wallace JC, Vodanovich SJ. Can Accidents and Industrial Mishaps be Predicted? Further Investigation into the Relationship between Cognitive Failure and Reports of Accidents. *J Bus Psychol.* 2003; 17(4): 503-14.
15. Lawshe CH, Steinberg MD. Studies in Synthetic Validity. I. An Exploratory Investigation of Clerical Jobs. *Pers Psychol.* 1955; 8(3): 291-301.
16. Lawshe CH. A Quantitative Approach to Content Validity. *Pers Psychol.* 1975; 28(4): 563-75.
17. Yaghmaei F. Content Validity and its Estimation. *SID.* 2003; 3(1): 25-27.
18. Shafaei Gholami P, Nassiri P, Yarahmadi R, Hamidi A, Mirkazemi R. Assessment of Contractors HSE Performance Based on Key Indicators in a Petrochemical Industrial Setting:(A Case Study). *Iran Occup Health.* 2014; 11(3).
19. Naseri A, Sepehri M, Mahmoudi S. Strategic Performance Evaluation of Health, Safety and Environment (HSE) Based on Balanced Scorecard (BSC), the Case Study of a Corporation in Energy Industry. *Iran Occup Health.* 2014; 11(1): 79-94.

Appendix

Row	Questions	Very Much	Much	Average	A Little	Little
1	The subjects regarding HSE are of high importance in the general meetings of the company.					
2	The responsible managers in the field of HSE use the obtained information from the auditors, observations, no-compatibilities, etc. in their policy reviewing regarding environment					
3	There are appropriate procedures for contributions of the personnel in affairs related to HSE and they can submit their recommendations regarding the improvement of HSE system performance					
4	The authorities of HSE unit the company have reduced the materials which are detrimental and dangerous to the environment to the minimum					
5	The top manager or his/her deputy has plans for creating communications and holding meetings regarding HSE and implements them					
6	The authorities of HSE unit provide the related employees with the periodical training courses as regards the methods of treating the various types of waste materials.					
7	The authorities of HSE unit of the company have emergency plans to discover the potential incidents and act in case of any environments situations and will implement these plans in case any problem occurs.					
8	The authorities of HSE unit of the company follow any recommended measures submitted in the field of environment to reduce the effects.					
9	The authorities of the HSE unit of the company provide the personnel with the description about the responsibilities, authorities and resources related to the environment as well as related activities regarding the reduction of environmental effects with respect to the educational needs assessments.					
10	There are procedures to discuss and exchange information between the top managers and the authorities of HSE unit regarding the issues of Health, Safety and Environment (HSE)					

- 11 With required environmental evaluations, the authorities of the HSE unit of the company strive to decrease the detrimental side effects resulted from the activities of the company on the surrounding environment.
- 12 The employees of the different departments are acquainted with the laws, regulations, directives and standards of the company in the field of HSE.
- 13 The authorities of the HSE unit of the company have an acceptable performance in recognizing the specialized educational needs relating to the type of performed operation in the company (fire control, etc)
- 14 The personnel of the company are informed about the risks related to their activities and processes and the operational controls.
- 15 The learned methods for data gathering and reporting on the semi-incidents and the observations have been conveyed to all departments in the organization.
- 16 There are certain predicted mechanisms for participation of the employees in the HSE plans and they contain the sufficient evident and records to implement them in a effective and proper way.
- 17 There are always informative announcements upon any semi-accidents and their analysis by the safety affairs authorities.
- 18 All issues are taught regarding any emergencies and response against occurrence of any crisis in the company.
- 19 The response plans in emergency situation are implemented based on the approved plans.
- 20 The authorities of HSE unit fully supervise the in charge employees in the field of waste collecting.
- 21 The top manger contributes to the plans and measures related to the promotion of HSE culture and distributing of the taught lessens from accidents and internal and external experience.
- 22 The fulfilled measures for obviating the environmental problems of the company are recorded and maintained.
- 23 The regular meetings with pre-defined time periods are held to specifically study the issues related to HSE.

- 24 The operational directives of the HSE filed are easy to understand and clear and compatible with the requirements of the integrated HSE management system.
- 25 The organizational structure, roles and the responsibilities regarding HSE include the competencies, the situations to meet the conditions are specified and defined and the employees of the HSE unit are aware of their role and responsibilities.
- 26 The state of the fulfillment of the objectives and the degree of their accessibility has been studied and the results of the previous studies are analyzed, rooted and reported.
- 27 The authorities of HSE unit train the employees professionally the methods of handling the safety tools as well as the safety methods and then issue the training certificate.
- 28 The authorities of HSE unit follows the reports on the defects observed during the internal and external evaluations.
- 29 The authorities in the different units of the company use the results of the auditing aiming at the continuous improvement after the completion of the safety auditing.
- 30 The authorities in the different units of the company report on the existing hazards in the field of HSE to the safety authorities.
- 31 The company have a certain and specified plan (HSE-plan) to perform its activities and this plan involves all of the area related HSE.
- 32 The filing of the records including time assessment, error assessment, and deviation assessment during the performing the maneuvers are carried out properly.
- 33 During the specified time periods the effectiveness of the danger warning alarms is properly assured.
- 34 The authorities of HSE control reduce or manage the different risks using executive measures.
- 35 The HSE unit authorities of the company evaluate the HSE requirements using the proper methods in the workplace continuously.
- 36 It has been defined the specified criteria to evaluate the HSE unit authorities performance by the top manager of the company and under his/her supervision and surveillance.

- 37 The authorities of HSE contributed to the reduction of the accidents in these departments with installing the special placards to warn about the hazards.
- 38 There are sufficient financial resources (from the financial, human resources, profession and knowledge, etc.,) at the disposal of the HSE unit.
- 39 The authorities of HSE unit of the company have the required ability to persuade the top manager of the company to assign the required budget for this field.
- 40 The authorities of HSE unit of the company prevent the company from wasting its financial and human resources by devising approaches such as hazard omission, engineering and management controls, separating the hazard resources and using personal protection tools.
- 41 The authorities of HSE unit of the company contributed to the reduction of the defected products and interruption in the production process by establishing a safe and comfortable environment ergonomically.
- 42 There are specific criteria regarding the recognizing of the suppliers of the raw materials as regards the issues related to the HSE.
- 43 The authorities of HSE unit are trying to reduce the wasted resources assigning the accountable resources based on the defined strategic objectives.
- 44 The authorities of HSE unit of the company are informed about the problems regarding HSE field of their personnel.
- 45 The authorities of HSE unit of the company study the reasonable and logic requests of the personnel regarding the issues relating HSE field and respond to them in an appropriate time.
- 46 The authorities of HSE unit of the company encourage the personnel of the company to observe the safety principles in workplace obviating the problems existed in the HSE field.
- 47 The personnel of the company contribute to the fields related to the HSE.

- 48 The authorities of the HSE unit detect any hazardous factors of any changes to be made to the equipment, machineries, working methods and personnel before any of such changes to be implemented.
- 49 The authorities of the HSE unit of the company take any required measures towards detecting the needs of the personnel regarding the HSE issues.
- 50 The authorities of the HSE unit are active in benchmarking, conveying of findings and experiences with other companies with similar activities.

Row	Questions	Excellent	Good	Average	Weak	Very weak
51	The authorities of the HSE unit are active in benchmarking, conveying of findings and experiences with other companies with similar activities.					
52	There are specified and written policies regarding the issues of HSE.					

Row	Questions	Always	Most often	Occasionally	Rarely	Not at all
53	The authorities of the HSE unit of the company proceed to change the timeworn safety tools in a regular time periods.					
54	The working relationship of the authorities of HSE unit is good with the outside departments including labor department, health center and social security.					
55	The authorities of the HSE unit of the company has a regular plan to detect and face with the executive-managerial challenges in the establishing a HSE system.					
56	The training plans of the personnel are updated periodically in the related fields of HSE.					
57	The authorities of the HSE unit of the company provide the newcomer personnel with the required training courses.					
58	The plan and schemes to fulfill the training requirements are devised in the acceptable time periods and approved by the different managerial levels.					

- 59 The produced wastes collected severally in different department (decaying materials, paper and plastics, dangerous chemical wastes including colors, sprays, etc.).
- 60 The educational needs of the employees are defined regarding issues related to HSE in all of the professions proportionate with the working risks and environment dimensions.
- 61 The policies related to the environmental fields are updated if required and prescribed by the related authorities.
- 62 The authorities of the HSE unit choose the best approach in the least cost regarding the HSE field using the cost-effective techniques.
- 63 The auditing plans are performed periodically in the HSE system.
- 64 The authorities of the HSE unit are trying to increase the internal and external costumers` consent providing the required preliminaries.
-