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DESIGNING A BALANCED SCORECARD MODEL DEVELOPED IN THREE MANAGERIAL LEVELS OF IRANIAN PUBLIC ORGANIZATIONS

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ABSTRACT

Today, remarkable changes to management science have made it inevitable to establish an evaluation system. Lack of such system in different sectors, including evaluation of resources and capabilities, managers, objectives and strategies, is considered a symptom of organizational diseases. This study aims to design a balance scorecard (BSC) model developed in three managerial levels of Iranian public organizations. It is a survey-field study where data was collected using pairwise-comparison questionnaire and the weight of criteria was calculated and normalized using fuzzy analytic hierarchical process (FAHP) and displayed as dashboard in 5 main fields. The sample size was n=384; all selected randomly among study population. This study has an exploratory nature. Therefore, study question was discussed instead of study hypothesis. It should be mentioned that this study dealt with experts and specialists. Comparison of the final weights of criteria in whole model showed that "managers' self-audit" and "number of complaints" had the maximum and the minimum weights, respectively.

Keywords: *Balanced Scorecard, Evaluation System, Public Organizations*

INTRODUCTION

Today, senior managers of many companies and organizations spend a considerable portion of their energy and financial resources to formulate essential strategies for their organizations. However, majority of them indicate that these strategies are not implemented ideally. Surprisingly, organizational perspective is completely clear but, the awareness and understanding of managers of this perspective are very low and they show less empathy for realizing the objectives derived from this perspective. Therefore, senior managers always seek for solutions to assure the implementation of their strategies. They have used evaluation methods as a tool for controlling the implementation of such strategies (Ebn-al-Rasdoul, 2014).

METHOD OF STUDY

This study aims to design performance evaluation model in three levels in Iranian public organizations using developed balanced scorecard. Therefore, it is a survey-field study. It collects data using pairwise-comparison questionnaire, obtains and normalizes criteria weight using fuzzy analytic hierarchical process (FAHP) and shows them as dashboard in five main

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fields. Required data is collected from study sample using face-to-face interviews and document review and, as the final step, the obtained results are generalized to whole population as the final step.

Study population

The study population of the quantitative part of this study consists of all managers of Plan and Budget Organization who are distributed, in accordance with organizational chart, in three levels namely: strategic or senior managers, mid-level managers and operational or general managers. Cochrans's sample size formula was used as follows to select sample size:

$$n = \frac{Nt^2 pq}{\varepsilon^2 (N-1) + t^2 pq}$$

Total number of evaluated cases is 384 who were selected in random among study population.

Objectives

Main objective

The main objective of this study is to identify and present the dimensions and criteria of developed BSC in a management dashboard framework.

Subsidiary objectives

1. Identification and determination of financial perspective criteria in senior managers level
2. Identification and determination of customer perspective criteria in senior managers level
3. Identification and determination of in-organizational process perspective criteria in senior managers level
4. Identification and determination of innovation perspective criteria in senior managers level
5. Identification and determination of ethics perspective criteria in senior managers level
6. Identification and determination of financial perspective criteria in mid-level managers level
7. Identification and determination of customer perspective criteria in mid-level managers level
8. Identification and determination of in-organizational processes perspective criteria in mid-level managers level
9. Identification and determination of innovation perspective criteria in mid-level managers level
10. Identification and determination of ethics perspective criteria in mid-level managers level
11. Identification and determination of financial perspective criteria in general managers level
12. Identification and determination of customer perspective criteria in general managers level
13. Identification and determination of in-organizational processes perspective criteria in general managers level
14. Identification and determination of innovation perspective criteria in general managers level

15. Identification and determination of ethics perspective criteria in general managers level

Study hypothesis

This study has an exploratory nature. Therefore, study questions are discussed instead of study hypothesis. It should be noted that, this study deals with experts and specialists.

Study background

Golara Samane and Zegardi (2016) suggested an integrated performance evaluation system based on developed BSC using AHP and DEMATEL techniques in order to identify and prioritize the relative priority and casual relationships of organizational criteria. Their results indicated that their proposed model is an applied model and could be generalized to other organizations. Tavallaei (2015) states in his study that, as long as organizations try to survive and feel the need for contribution to national and international arenas, they shall consider the principle of continuous improvement. He defines performance evaluation in terms of managers, use of capabilities and resources and organization. He explains different views about performance evaluation, describes the general process of performance evaluation in organizations and introduces conventional models of performance evaluation. Khatami Firozabadi and Izadkhah (2013) argued in their study that, modern organizations involve in different challenges in ever-changing and complex national and international environments. They considered very different weights for financial, market, internal process, and growth and extracted learning criteria. This implies the necessity of weigh allocation using BSC technique. Rouhollah Ramazanzade Badele (2011) conducted a study titled "BSC for implementing the strategies of Khatam-al-Anbia Construction Headquarter". Following the determination and clarification of the mission and perspective of the studied organization, he used BSC model to define organizational objectives in terms of four dimensions of BSC. He determined the values of performance evaluation system and selected relevant BSC model. Then, he answered the study questions and offered the efficiency measures associated with key factors by developing the strategic map of the headquarter. Rouhollah Askari (2012) conducted a study titled "performance evaluation in Yazd Universities of Medical Sciences using DEA". He suggested that other techniques including BSC should be used to compare their results with his results in order to identify inefficient units and guide them to improve their efficiency and obtain special advantages in hospitals with better performance level. Mohammad Asadi Mir et al (2010) conducted a study titled "performance assessment in public hospitals using BSC, DEA and SERVVQUAL models". This study evaluated the relative efficiency of 13 hospitals of the studied province using a combination of DEA and BSC. Eshagh Dehghani (2014) evaluated the branches of Bank Shahr using BSC. The results of AHP pairwise comparisons showed that amongst the four dimensions of BSC, customer dimension has the highest importance followed by financial dimension where internal processes, and growth and learning, have the same importance.

Arabmazar et al (2009) conducted a study titled "evaluation of tax performance of Tehran municipality using BSC" and concluded that this performance is in an ideal level. The important outcome of their study was that it confirmed the awareness of the municipality senior managers' of the necessity of strategic thinking in tax affairs. The most comprehensive study outside Iran was conducted by Wi Yu and Chen in 2009 where they assessed the performance of banks using FHA and BSC. Their results showed that combining FHA and

multi-criteria decision-making could serve, with the aid of BSC, as a beneficial tool for evaluating and ranking banks and institutes. Ghalayni et al (2015) stated in their study that as far as organizations try to survive and feel the necessity of contribution to national and international arenas, they should consider the principle of continuous improvement. They defined performance evaluation in terms of managers, use of resources and capability and organization dimensions, introduced different views about performance evaluation, explained its general process in organizations and introduced conventional models of performance evaluation. Banoot and Deshmakh (2016) presented in their study a model for evaluating the performance of non-industrial research centers. At the end of their study, they evaluated a non-industrial center as a case using their proposed model. Wong (2015) states in his study that performance improvement is currently the first lines of the minutes of many organizations across the world so that considering the development of performance evaluation techniques, it is necessary to select a technique with the maximum possible return on investment.

While EFQM supports TQM principles, BSC emphasizes organizational strategy. Hedy Sandind et al (2009) studied a public electric industry company in Australia that had adopted BSC. According to their results, BSC has the potential for judging, replacing and balancing objectives. Emad Al-Siuf (2015) proposed a strategic system for measuring retention and maintenance performance. He adopted BSC framework to evaluate the contribution of retention and maintenance to the realization of strategic objectives. He found adjusted BSC could identify and measure the high-level relationships of an effective retention and maintenance strategy. He evaluated the effect of this technique on the competitive advantages of enterprises.

RESULTS

Identification of final criteria and sub-criteria

The criteria and sub-criteria of study were first identified and selected. The main criteria are 1) financial, 2) customer, 3) in-organizational processes, 4) innovation and 5) ethics and social accountability. This study aims to apply improved BSC model to three levels namely: senior managers (strategic level), mid-level managers (tactic level) and general managers (general level). To this end, some sub-criteria were defined for each criterion in every managerial level. In summary, 5 main criteria and 30 sub-criteria, for senior managers, 31 sub-criteria for mid-level managers and 29 sub-criteria for general managers (total sub-criteria=90) were defined.

Priority of criteria and sub-criteria

An 8-stage process is used to conduct FHA and determine the priority of criteria and sub-criteria. The stages are explained in the following:

Stage 1: collecting experts' answer

This stage first conducts pairwise comparison on main criteria, with respect to objective, and on sub-criteria, with respect to the relevant main criteria, in all managerial levels using Saaty's nine-point scale questionnaire. Verbal propositions and crisp values of each proposition in Saaty's questionnaire are as follows:

Stage 2: Fuzzification of experts' view

This stage quantifies experts' view using fuzzy scale. This study adopts Chang's FAHP (1996) shown in the following table. In this stage, the questionnaires are submitted to experts and they score them using Saaty's nine-point scale. In this way, pairwise comparison matrix is formed

by the fuzzification of experts' view. According to Chang's FAHP method (1996), arithmetic mean of answers should be calculated. Therefore, following the collection of experts' views with Saaty's nine-point scale and fuzzification of their views, the answers are accumulated using fuzzy average. Fuzzy average of the views of n responders is calculated from the following equation:

$$f_i = (l_i, m_i, u_i)$$

$$Fuzzy\ Average = [\frac{l_1 + l_2 + l_3 + ...l_n}{n}, \frac{m_1 + m_2 + m_3 + ...m_n}{n}, \frac{u_1 + u_2 + u_3 + ...u_n}{n}]$$

Stage 3: calculating fuzzy sum of every raw

Following the calculation of fuzzy average for pairwise comparison matrices, eigenvector should be calculated. To do so, the fuzzy sum of each raw is first calculated by equation 2:

$$\sum_{j=1}^{n} M_{g_1}^{j} = (\sum_{j=1}^{n} l_i^j, \sum_{j=1}^{n} m_i^j, \sum_{j=1}^{n} u_i^j)$$

Stage 4: calculating normalized fuzzy weight (S_i)

Following the calculation of the fuzzy sum of each raw, normalized fuzzy weight (combined fuzzy expansion) is calculated for each criterion using equation 3:

$$S_i = \sum_{J=1}^{m} M_{g_i}^{j} \otimes [\sum_{i=1}^{m} \sum_{j=1}^{n} M_{g_i}^{j}]^{-1}$$

To calculate combined fuzzy expansion, the total value of each criterion should be divided by the sum of all priorities (column arrays). Since they are fuzzy values, the fuzzy sum of each raw is multiplied by inverse sum.

Stage 5: Defuzzification and calculation of eigenvector

Different techniques are used to defuzzify obtained values. Calculating possibility degree and crisp number is an example. Defuzzification of obtained values for calculating crisp number is processed as follows:

$$x_{\max}^{1} = \frac{l + m + u}{3}$$

$$x_{\max}^{2} = \frac{l + 2m + u}{4}$$

$$x_{\max}^{3} = \frac{l + 4m + u}{6}$$

$$Crisp\ Number = Z^{*} = \max\{x_{\max}^{1}, x_{\max}^{2}, x_{\max}^{3}\}$$

Stage 6: Inconsistency assessment

This study uses Gogus and Boucher method to calculate inconsistency. The inconsistency rate of the fuzzy matrices of pairwise comparison is calculated through the following steps:

Step 1: in the first step, triangular fuzzy matrix is divided to two matrices. The first matrix is constituted by the middle numbers of triangular judgments, $A^m = [a_{ijm}]$, and the second one covers geometric means of the upper and lower triangular judgments, $A^g = \sqrt{a_{iju}.a_{ijl}}$

Step 2: the weight vector of each matrix is calculated using Saaty's method as follows:

$$w_i^m = \frac{1}{n}\sum_{j=1}^{n}\frac{a_{ijm}}{\sum_{i=1}^{n} a_{ijm}} \quad \text{where } w^m = [w_i^m]$$

$$w_i^g = \frac{1}{n}\sum_{j=1}^{n}\frac{\sqrt{a_{iju}.a_{ijl}}}{\sum_{i=1}^{n}\sqrt{a_{iju}.a_{ijl}}} \quad \text{where } w^g = [w_i^g]$$

Step 3: the maximum eigenvalue is calculated for each matrix using the following relations:

$$\lambda_{\max}^m = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} a_{ijm}\left(\frac{w_j^m}{w_i^m}\right)$$

$$\lambda_{\max}^g = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n}\sqrt{a_{iju}.a_{ijl}}\left(\frac{w_j^g}{w_i^g}\right)$$

Step 4: consistency index is calculates using the following relations:

$$CI^m = \frac{(\lambda_{\max}^m - n)}{(n-1)}$$

$$CI^g = \frac{(\lambda_{\max}^g - n)}{(n-1)}$$

Step 5: to calculate inconsistency rate, CI is divided by RI. If the results is <0.1, the matrix will be consistent and usable. The inconsistency rate is calculated for two matrices from the following relations and the obtained values are compared with the threshold value i.e.0.1:

$$CR^g = \frac{CI^g}{RI^g}$$

$$CR^m = \frac{CI^m}{RI^m}$$

Since all CR^g and CR^m values are <0.1 for conducted pairwise comparisons, it can be concluded that mean pairwise comparison is consistent and there is no inconsistency between experts' answers.

Step 7: the overall weight of each sub-criterion is calculated for each managerial level. To do so, the relative weight of a sub-criterion is multiplied by the weight of relevant criterion.

Step 8: the overall weight of sub-criteria in whole model is calculated for all managerial levels. To do so, the weights calculated in previous step are multiplied by the relative weight of relevant managerial level. The following table shows the overall weight of 90 studied sub-criteria:

Table 1: Final weight of sub-criteria in model

Sub-criterion	Final weight in model	priority
Ratio of current to previous market price	0.007285	83
Annual sales	0.007424	81
Ratio of total assets to managers	0.008833	63
Annual revenue	0.009031	61
Total expenses	0.009632	41
Working capital	0.012197	23
External sales rate	0.007416	82
Ratio of export to total sales value	0.007611	76
Customer satisfaction	0.008906	62
Internal sales rate	0.009147	55
Ratio of annual sales to number of customers	0.010861	33
Ratio of export value to marketing expenses	0.013673	16
Product reliability	0.006642	88
Ratio of total wastes to total production	0.007473	79
Production-related purchases	0.007505	78
Ratio of material consumption to product costs	0.008162	70
Ratio of number of current inventory shrink to number of current shortage	0.00912	58
Ratio of material inaccessibility-induced losses to total production	0.009136	57
Exchange intensity of raw consuming material	0.009562	44
Development of organizational resources	0.009381	50
Succession plan	0.009612	43
Development of organizational culture	0.011268	28
Enhancement of organizational integrity	0.011988	25
Strategic renovation	0.012187	24
Idea developing	0.012767	21
Minimization of attraction and change cost	0.01337	18
Strengthening legal and social processes	0.013757	15
Ethical development of managers	0.013863	14
No need for costly out-organizational supervisions	0.017432	7
Compensation and punishment system	0.021603	4
Settlement of accounts payable	0.009093	60
Settlement of accounts receivable	0.009179	53
Dividend income	0.009208	52
Mean value of stocks	0.010578	35
Inventory turnover of row materials	0.011184	30
Total inventory turnover of built products	0.013661	17
Customer satisfaction with delivery time	0.007452	80
Customer satisfaction with price	0.008253	68
Organization rank in customers' view	0.008356	67
Customer satisfaction with customer relationship	0.008766	64
Customer satisfaction with products quality	0.009794	40
Customer loyalty	0.011213	29
Customer satisfaction with product function	0.012769	20

Equipment efficiency	0.007519	77
Material efficiency	0.008214	69
Human resource efficiency	0.008523	65
Ratio of added value to machinery depreciation	0.009504	47
Ratio of total losses to total consumed material	0.010733	34
Ratio of number of new suppliers to total number of suppliers	0.011044	32
Quality level of products	0.011067	31
Communication improvement	0.010161	37
Creating empathy and sympathy spirit	0.010415	36
Creating competitive environment	0.011709	26
Implementation of idea	0.013929	13
Organizational innovation	0.015498	10
Knowledge share	0.016005	9
Acknowledging and supporting the performance of top employees	0.01418	12
Enhancement of customers' trust and confidence	0.014911	11
Transparent accounting system	0.01664	8
Minimizing in-organizational frauds and deception	0.020448	5
Minimizing negligence and damage costs	0.026344	2
Current ratio	0.007108	85
Ratio of total operational costs to sales value	0.008478	66
Ratio of total distribution costs to sales value	0.009097	59
Quick ratio	0.009148	54
Ratio of total sales costs to sales value	0.009388	49
Ratio of total general and administrative costs to sales value	0.009484	48
Number of complaints	0.006261	90
Mean customer size	0.006963	87
Contribution of internal market	0.007205	84
Number of new purchase applicants to total number of applicants	0.007754	73
Ratio of number of customers to number of managers	0.007758	72
Number of customers	0.009897	39
Number of lost customers	0.009966	38
Ratio of mean delivery time to standard delivery time	0.006633	89
Repair rate	0.006987	86
Operation time	0.007644	75
Technology optimization	0.007687	74
Ratio of human resource-induced defects	0.007779	71
Execution time	0.00953	46
Set-up time	0.009545	45
Delegation of authority and freedom to managers	0.009146	56
Enhancement of managers' satisfaction	0.009233	51
Process innovation	0.009623	42
Product innovation	0.011554	27
Enhancement of education effectiveness	0.01234	22
Exploiting ideas	0.013207	19
Assisting the elimination of mental concerns of managers associated with out and in-organizational issues	0.017988	6

Meeting managers' exceptions	0.025549	3
Managers' self-audit	0.033985	1

Comparison of the final weight of criteria in whole model indicates that "managers' self-audit" and "number of complaints" have the maximum and the minimum weights, respectively. The priority of sub-criteria is shown in above table.

CONCLUSION

Comparison of the final weight of criteria indicates that "in-organizational processes" and "financial criteria" have the maximum and the minimum weights, respectively. In addition, the comparison of levels weight indicates that "mid-level managers" and "general managers" have the maximum and the minimum weights, respectively. Moreover, "working capital" and "ratio of current to previous market value" have the maximum and the minimum weights, respectively and "ratio of the export value to marketing expenses" and "ratio of exports to total sales and total external sales" have the maximum and the minimum weights, respectively. Furthermore, "exchange intensity of consuming raw materials" and "product reliability" have the maximum and the minimum weights, respectively and "idea developing" and "succession and development of organizational resources" have the maximum and the minimum weights, respectively. According to the comparison, "compensation and punishment system" and "minimizing attraction and change of human resource cost, strengthening legal and social processes and ethical development of managers" have the maximum and the minimum weights, respectively and "inventory turnover of total built product" and "settlement ratio of accounts payable" have the maximum and the minimum weights, respectively. In addition, "customer satisfaction with product function" and "customer satisfaction with delivery time" has the maximum and the minimum weights, respectively. "Ratio of number of new suppliers to total number of suppliers" and "equipment efficiency" have the maximum and the minimum weights, respectively. The comparison shows that "organizational innovation" and "improvement of communication and creation of empathy and sympathy moral" have the maximum and the minimum weights, respectively and "minimizing negligence and damage costs" and "acknowledging and supporting top employees" have the maximum and the minimum weights, respectively. Moreover, "ratio of total sales costs to sales value and ratio of total general and administrative costs to sales value" and "current ratio" have the maximum and the minimum weights, respectively. According to the comparison, "number of customers and number of lost customers" and "number of complaints" have the maximum and the minimum weights, respectively and "set-up time and execution time" and "ratio of mean delivery time to standard delivery time" have the maximum and the minimum weights, respectively. In addition, "exploiting idea" and "enhancement of managers' satisfaction and delegation of authority and freedom to managers" have the maximum and the minimum weights, respectively whereas "managers' self-audit" and "assisting the elimination of managers concerns about in and out-organizational issues" have the maximum and the minimum weights, respectively.

In order to calculate the relative weight of each sub-criterion in each managerial level, the relative weight of a criterion is multiplied by the weight of relevant criterion. The comparison of the final weight of criteria in senior managers level shows that "compensation and

punishment system' and "product reliability" have the maximum and the minimum weights, respectively. The following figure shows the priority of the studied criteria.

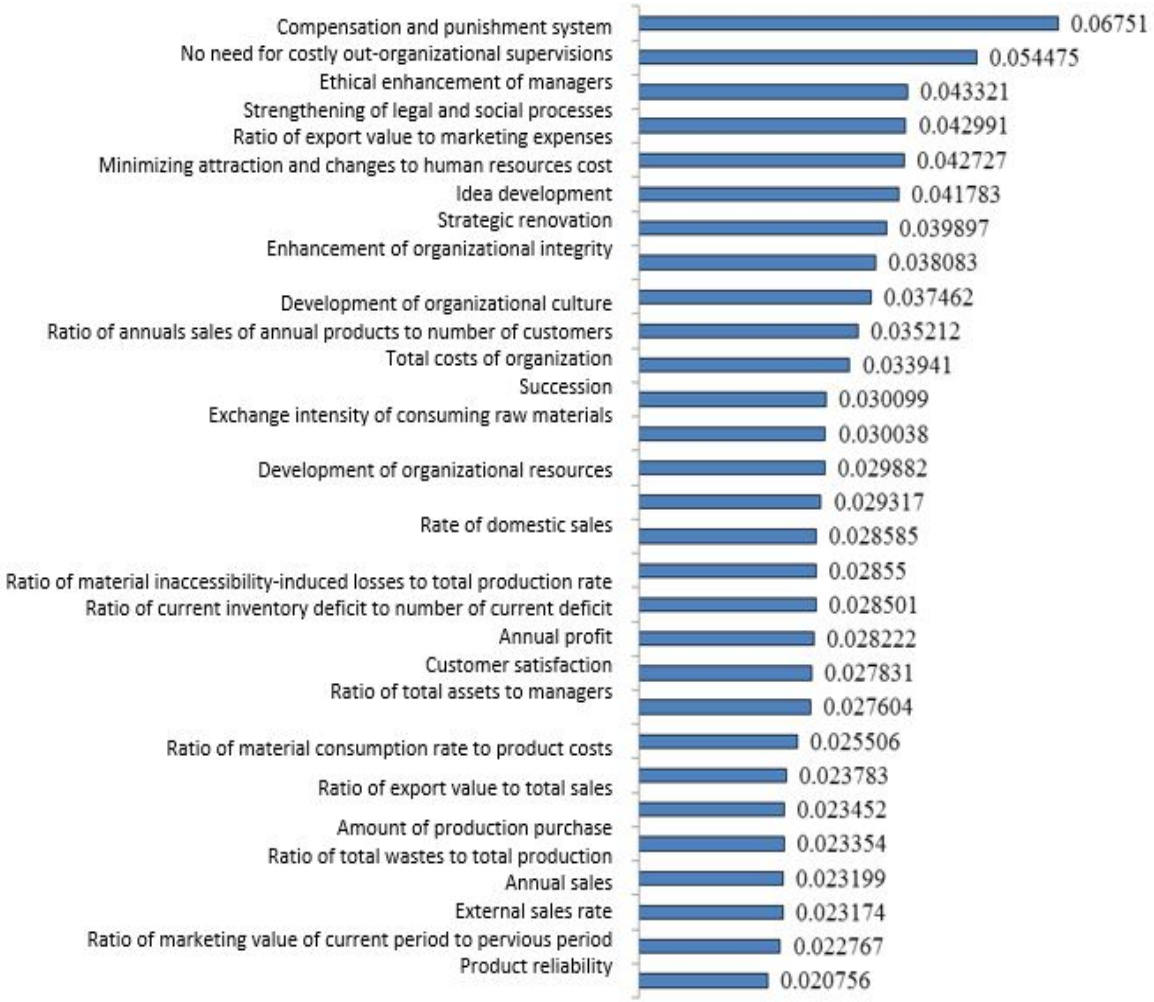

Figure 1: final weight of sub-criteria in the level of senior managers

Comparison of the final weight of criteria in mid-level managers level indicate that "minimizing negligence and damage costs" and "customer satisfaction with delivery time" have the maximum and the minimum weights, respectively. Moreover, "managers' self-audit" and "number of complaints" have the maximum and the minimum weights, respectively. To obtain the overall weight of sub-criteria in whole model in all three managerial levels, the calculated weights of previous step are multiplied by the relative weight of managers' level. The comparison of the final weight of criteria in whole model shows that "managers' self-audit" and "number of complaints" have the maximum and the minimum weights, respectively.

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