Competency Assessment Using Key Performance Indicators

Toader Elena Alexandra
The Bucharest University of Economic Studies

Laura Brad
The Bucharest University of Economic Studies

DOI: 10.6007/IJARBSS/v5-i6/1658 URL: http://dx.doi.org/10.6007/IJARBSS/v5-i6/1658

Abstract. *The paper proposes a method for computing the scores of the key performance indicators resulted in the competency assessment process. The key performance indicators are estimated considering four performance levels that an IT professional can obtain at the end of the assessment process. We suggest as the best approach for estimating the performance key indicators an online questionnaire filled by 60 employees that work in IT Romanian companies. The results provide evidence that the differences between the levels of performance are quite small. The employees of the IT companies had similar features and characteristics no matter what is their level of performance. Based on this analysis, the computed performance key indicators can be integrated into an online competency assessment tool that will help organizations in measuring the performance of their technical professionals.*

Keywords: competency register, human resource management, IT competency assessment, key performance indicators

JEL classification: C13, C43

Introduction

The IT environment is competitive and the traditional management methods are not considered appropriate nowadays. The rapid development of the databases, web technologies and automation tools lead to use these new methods in daily tasks. Measuring the performance of the IT professionals is one of the most important decision system that a manager can use (Rezaei et al., 2011).

The importance of an assessment system for the competencies is underlined at both organizational and individual level Macky&Johnson(2010). The actual performance level can be computed as a difference between the desired level and the assessed level of competencies that the employee possesses. The main advantage is the feedback resulted at the end of the assessment process that can help the professional in improving his actual level of performance. The performance of an IT

professional can include: the quantity, the quality of software code, the deadlines and the team work (Güngör, 2011).

The main factors that influence the performance management in different studies are based on a combination of criteria as: the activity domain, the security, the quality of the employees, the customer satisfaction. The most important methods used for performance computation are: the score method, the performance pyramid, genetic algorithms. The most common tools that reveal the methods used is the online questionnaires. By defining a range of skills it can be evaluated and finally measured the performance for each employee.

1. Literature review

The key performance indicators are used by the software organizations in the competency assessment process of their IT professionals. The key performance indicators turns into strategic objectives of the organization in the long term. Establishing clear and feasible indicators contributes to transparency and validity of the competency assessment process Tsai&Cheng(2012).

The key performance indicators represent a quantitative index which can measure and assess the IT professionals' competencies, thus defining success factors of organizations. Selection of the key performance indicators should depend on the context in which the organization will carry out the assessment process, each indicator must be consistent with the organizational objectives and must be quantified. The key performance indicators have an important role to identify, analyse and evaluate the IT professional competencies, but also provide data and actual information about the current state for the competency assessment process.

Brown(1996) considers that a valid competency assessment system must have some essential characteristics: must contain few key performance indicators, the indicators must be defined in relation to the success factors, the indicators should cover issues related to both current and past state of competency level achieved. The design of indicators must be in the interest of all participants in the assessment process, several indicators combined should provide a more comprehensive assessment and the process must be adaptable for the organizations' goal.

Yeung et al. (2009) used a Delphi method which defined indicators in order to measure, monitor and improve the performance of the employees. They have extended the system and have created graphics to easily identify the level of the competencies that the employees must improve. Ahmad and Dhafr (2002) have suggested that the key performance indicators must combine both internal and external organizations' factors and its values must be computed according to other processes. Zairi (1994) considers that all the time, the key performance indicators must be monitored and updated according to the organizational' strategic objectives.

The key performance indicator represents a standard in each domain of applicability, university and its measurement is difficult to make after a pattern. A lot of research has been conducted in order to establish the influencing factors of the key performance indicators, trying to integrate it into the structural domain, into management organization domain, to depend on the control and coordination of work, to depend on research and programming the processes Shen (2005).

2. Framework for defining the competency key performance indicators

The model used for designing the framework for the identification and calculation of the key performance indicators was defined by Masron et al. (2011) and was adapted on the competency model defined by de Bodea&Toader (2013) in which were defined 3 competency category: methodical, personal-social, strategic-organizational.

In Figure 1 has been described the framework for the key performance indicators starting from the competency model defined by Bodea&Toader (2013).

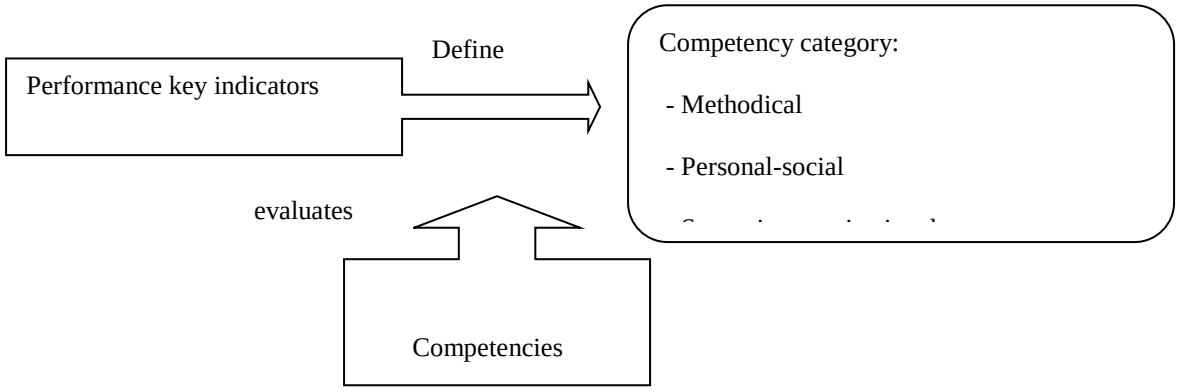

Figure 1. The key performance indicators framework (Adapted after Masron et al. 2011)

3. Research methodology

In order to assess the IT competencies, Bodea& Toader (2013) found several factors of influence. They can be split into three competency categories: F1- Methodical Factors, F2: Personal-Social Factors and F3: Strategic-Organizational Factors. The secondary factors were defined by Bodea&Toader (2012) in their PM competency model. There are 18 secondary indicators that are used to define the key performance indicators and that are needed to assess the IT competencies.

In Table 1, we present both the main indicators and the secondary one.

Table 1. Grouping factors of influence in competency categories

Main factors	Secondary factors
I_1 (Methodical Factors)	I_{11} - Knowledge of applied PM methods
	I_{12} - Technical analysis of information
	I_{13} - Automation and information of working process
	I_{14} - Evaluation, review and quality assurance of work
	I_{15} -Implementation of maintenance techniques
I_2 (Personal-Social Factors)	I_{21} - Teamwork
	I_{22} - Creativity
	I_{23} - Vigilance
	I_{24} - Efficiency
	I_{25} - Motivation
	I_{26} - Ethics
	I_{27} - Stress resistance
I_3 (Strategic-Organizational Factors)	I_{31} - Permanent organization
	I_{32} - Health, security, safety and environment
	I_{33} - Respect of work methods and procedures

Source: Bodea & Toader (2012)

Each key performance indicator that is use to assess the IT professionals competencies is going to be linked with a value or a score. As a fact, there is a need to have an adjustment mark. Based on our knowledge, there is not a standard method on which the scores are computed, but we considered the methodological approaches conducted by Li-Yin et. al (2005), Uren & Griffiths(2000), Wathey & Reilly (2000).

We define the final score for assessing the IT professional competencies as the sum of the results found for assessing all secondary factors that were grouped afterwards in three main factors of influence. The formula that we used is presented in equation (1)

$$EV_{comp} = \sum_{i=1}^{3} W_i SI_i \qquad (1)$$

Where

International Journal of Academic Research in Business and Social Sciences
June 2015, Vol. 5, No. 6
ISSN: 2222-6990

SI_i is the score of the key performance indicator I_i.

It was considered each factor of influence is different from each other. As a fact, we assigned a particular weight W_i for each of the three main factors.

Considering the IPMA (2006) Standard, for each factor of influence it was assigned a weight according to the degree of performance that was achieved. The Methodical Factors are related with technical knowledge that an IT professional has to use in order to fulfill his daily tasks. The Personal-Social Factors are related with the behavior features that the employee has to use in his relationship with his colleagues and with himself. The Strategic-Organizational Factors are correlated with the rules and the regulation that the employee has to keep in relation to organizational methodologies. As a fact, based on the factors of influence, we assigned weights for each level of performance. Consequently, we assigned higher weight for Methodical Factors as the performance was higher, while the weights for the Personal-Social Factors and for the Strategic-Organizational Factors were smaller. When the performance is lower, the weights for the Strategic-Organizational Factors and for the Personal-Social Factors are higher, while the weight for the Methodical Factors is lower.

In Table 2, we provide evidence of the weights W_i assigned for each factor of influence I_i that is related with a specific level of performance

Table 2. The weight assigned to each factor of influence I_i

Factor of influence/ the weight of the level of performance	W_{cons}	W_{fam}	$W_{ext\ know}$	$W_{\exp}$
I_1 (Methodical Factors)	40	50	60	70
I_2 (Personal-Social Factors)	35	30	25	20
I_3 Strategic-Organizational Factors	25	20	15	10

Source: author's calculation

Where:

W_{cons} represents the level of performance Consciousness or Awareness

W_{fam} represents the level of performance Familiarization or Acquaintance

$W_{ext\ know}$ represents the level of performance Extensive Knowledge

$W_{\exp}$ represents the level of performance Expertise

Paquette (2010) defines the following factors that are used to measure performance: frequency, practicability, autonomy, and complexity of tasks and the context of usage. For example, the analyzing of the following sentence "finding the errors in software applications" can be done by adding several performance indicators that are related with frequency such as always and sometimes, that are related with practicability feature such as partial or total, that are related with autonomy such as with aid,

without aid and that are correlated with the context of usage such as difficult cases and less complex cases. In Table 3, we present the levels of performance defined by Paquette (2010).

Table 3. Levels of Performance

Performance indicator	Consciousness or Awareness	Familiarization or Acquaintance	Extensive Knowledge	Expertise
Frequency	Sometimes	Always	Always	Always
Practicability	Partial	Partial	Total	Total
Autonomy	With aid	With aid	Without aid	Without aid
Complexity of tasks	Small	Small	Advanced	Highest
Context of usage	Less complex cases	Less complex cases	Complex cases	Complex cases

Source Paquette, 2010: pp.93-175

For each level of performance, we are going to assign a weight considering each factor of influence. Each factor of influence I_i is composed from several performance indicators I_{ij}. It is considered that each key performance indicator I_{ij} has different weights in the structure of I_i. The score SI_i is defined as the sum of each key performance indicator I_{ij} which is weighted with is value. This aspect is found in equation (2):

$$SI_i = \sum_{i=1}^{x} p_{ix} SI_{ij} \qquad (2)$$

Where:

x is the number of key performance indicators that are related with each factor of influence

SI_{ij} is the score computed for each key performance indicator I_{ij} and the way it was calculated is presented in equation (3)

$$SI_{ij} = \frac{\sum_{i=1}^{x} RI_{ij}}{\sum_{i=1}^{x}\sum_{j=1}^{4} RI_{ij}} \times 100 \qquad (3)$$

Where

p_{ix} is the weight for each score of the key performance indicators SI_{ij} (it is computed considering equation (4))

$$p_{ix} = \frac{z_{Ri} \times RI_{ij}}{\sum_{i=1}^{x} RI_{ix}} \qquad (4)$$

Where:

z_{Ri} is the frequency of the number of times the answer appeared for the key performance indicator I_{ij}

RI_{ij} is the answer relate with the key performance indicators I_{ij}

j is related with each factor of influence, $j = \overline{1,3}$

x is the number of key performance indicators for each factor of influence

RI_{ix} is the number of answers for each factor of influence

The use of the key performance indicators together with the grouping process of the factors of influence on competency levels is a method that has a transparent approach of the IT assessment, based on which the scores for each competency is going to be computed.

When we analyse the relations from equations (1), (2) ,(3) and (4), we observe that we have some variables, such as SI_i, SI_{ij}, p_{ix}, z_{Ri}, RI_{ij}, RI_{ix} that are unknown. In order to determine their value, we conducted a qualitative research based on a questionnaire that has 15 questions that look at each key performance indicator I_{ij}. Each question has 4 possible answers that are related with each level of performance. The questions are close questions, with only an answer option. This questionnaire was given to IT professionals who work in Software Romanian Companies. In order to encourage the employees to fill in, the questionnaire was sent to 100 IT employees by e-mail and 60 IT professionals answered to our request.

4. Results and discussions

The aim of this research is to compute the unknown elements from equations (1), (2), (3) and (4). In order to solve this problem, we are going to provide evidence about the scores for the key performance indicators I_{ij}, for each level of performance and for each factor of influence. Table 4 presents the results found for each key performance indicator I_{ij}.

Table 4. The results found for each key performance indicator I_{ij}.

Performance indicator	Consciousness or Awareness	Familiarization or Acquaintance	Extensive Knowledge	Expertise
I_{11}- Knowledge of applied PM	6	12	12	30

methods				
I_{12} Technical analysis of information	12	12	12	24
I_{13} Automation and information of working process	6	12	18	24
I_{14} Evaluation, review and quality assurance of work	6	12	12	30
I_{15} Implementation of maintenance techniques	6	12	18	24
I_{21} Teamwork	6	18	12	24
I_{22} Creativity	12	12	18	18
I_{23} Vigilance	6	6	18	30
I_{24} Efficiency	12	12	12	24
I_{25} Motivation	6	12	18	24
I_{26} Ethics	12	6	12	30
I_{27} Stress resistance	12	18	6	24
I_{31} Permanent organization	6	12	12	30
I_{32} Health, security, safety and environment	12	18	12	18
I_{33} Respect of work methods and procedures	12	6	18	24

Source: author's calculation

From Table 4, we found the values for z_{Ri}, and RI_{ij} and consequently, we could multiple them. Based on this, we can compute the weights of each key performance indicator for each factor of influence. The results are presented in Table 5.

Table 5. The weights for each hey performance indicator for each factor of influence

Key performance indicators	Consciousness or Awareness	Familiarization or Acquaintance	Extensive Knowledge	Expertise
I_{11}- Knowledge of applied PM methods	0,10	0,20	0,20	0,50
I_{12} Technical analysis of information	0,20	0,20	0,20	0,40

I_{13} Automation and information of working process	0,10	0,20	0,30	0,40
I_{14} Evaluation, review and quality assurance of work	0,10	0,20	0,20	0,50
I_{15} Implementation of maintenance techniques	0,10	0,20	0,30	0,40
I_{21} Teamwork	0,10	0,30	0,20	0,40
I_{22} Creativity	0,20	0,20	0,30	0,30
I_{23} Vigilance	0,10	0,10	0,30	0,50
I_{24} Efficiency	0,20	0,20	0,20	0,40
I_{25} Motivation	0,10	0,20	0,30	0,40
I_{26} Ethics	0,20	0,10	0,20	0,50
I_{27} Stress resistance	0,20	0,30	0,10	0,40
I_{31} Permanent organization	0,10	0,20	0,20	0,50
I_{32} Health, security, safety and environment	0,20	0,30	0,20	0,50
I_{33} Respect of work methods and procedures	0,20	0,10	0,30	0,40

Source: author's calculation

From Table 5, we have computed the weights p_{ix} for individual scores of each key performance indicator SI_{ij}.

Considering the answers that we receive and the factors of influence, we computed the scores that were assigned to each key performance indicator. The results are presented in Table 6 (for each competency indicator we added the results found for each level that are related with a particular key performance indicator I_{ij})

Table 6. The scores for each key performance indicator

Factor of influence/weight of performance level	Consciousness or Awareness	Familiarization or Acquaintance	Extensive Knowledge	Expertise
I_1 (Methodical Factors)	$\frac{36}{300}\times 100 = 12$	$\frac{60}{300}\times 100 = 20$	$\frac{72}{300}\times 100 = 24$	$\frac{132}{300}\times 100 = 44$

I_2 (Personal-Social Factors)	$\frac{66}{420}\times 100 = 16$	$\frac{84}{420}\times 100 = 20$	$\frac{96}{420}\times 100 = 23$	$\frac{174}{420}\times 100 = 41$
I_3 Strategic-Organizational Factors	$\frac{30}{180}\times 100 = 16$	$\frac{36}{180}\times 100 = 20$	$\frac{42}{180}\times 100 = 24$	$\frac{72}{180}\times 100 = 40$

Source: author's calculation

Considering the results presented in Table 6, we can compute the general score for each performance indicators. The results are presented in Table 7.

Table 7. The general/whole score for each factor of influence

Factor of influence	I_1 (Methodical Factors)	I_2 (Personal-Social Factors)	I_3 Strategic-Organizational Factors
Total	153,8	201,3	92,8

Source: author's calculation

Where

$$153.8 = 12\times(0.10+0.20+0.10+0.10+0.10)+20\times(0.2+0.2+0.2+0.2+0.2)+$$
$$+24\times(0.20+0.20+0.30+0.20+0.30)+44\times(0.50+0.40+0.40+0.50+0.40)$$

Based on the whole score of each factor of influence, we can compute the total score for each level of performance. The results are presented in Table 8.

Tabel 8. The score assigned to each level of competency

Score	Consciousness or Awareness	Familiarization or Acquaintance	Extensive Knowledge	Expertise
Total	120	123	126	129

Source: author's calculation

Where

$$120 \cong 130.4\times 0.4 + 181.953\times 0.35 + 17.335\times 0.25$$

5. Conclusions

This research tried to compute the scores for the key performance indicators considering four level of performance that an IT professional can obtain after his competency assessment process. The research presents both the intermediary stages and the general value of the key performance indicators

scores. The research has also a qualitative approach as it uses a questionnaire that was filled by 60 employees from an IT company. The results provide evidence that the differences between the levels of performance are quite small, which reflect that the employees of the IT company had similar features and characteristics no matter what is their level of performance. This result is related with the particularities that the IT projects that are applied into the company have.

The problems of the research are related with the small dimension of the sample on which analysis was conducted answered to the questionnaire). As a fact, in order to generalize our conclusion, we intend to repeat the analysis on a larger sampler. Moreover, we intend to provide additional information about the meaning that each entity applies for each level of competency. For further research, we aim to analyse the IT online job offers from Romania (the job offers are put on sites such as Ejobs, Best Jobs, and LinkedIn) and to compute the scores for each level of competency and for each key performance indicator.

Acknowledgements

This paper was co-financed from the European Social Fund, through the Sectorial Operational Programme Human Resources Development 2007-2013, project number POSDRU/159/1.5/S/138907 "Excellence in scientific interdisciplinary research, doctoral and postdoctoral, in the economic, social and medical fields -EXCELIS", coordinator The Bucharest University of Economic Studies.

References

1. Ahmad, M.M., Dhafr, N., 2002. Establishing and improving manufacturing performance measures. Robot. Comput. Integr. Manuf. 18, 171–176
2. A.R. Rezaei ∗, T. Çelik, Y. Baalousha, Performance measurement in a quality management system, Scientia Iranica E (2011) 18 (3), 742–752
3. Bartol, K.M., Srivastava, A., 2002. Encouraging knowledge sharing: the role of organizational reward systems. Journal of Leadership and Organization Studies 9, 64–76.
4. Bodea C. N., E-A. Toader, "Ontology-based modeling of the professional competencies - a comparative analysis", 11th International Conference on Informatics in Economy (IE 2012), Education, Research and business Technologies, Bucharest, May 2012, pp. 452-458 ;
5. Bodea C. N., E-A. Toader, "Developement of the PM competency model for IT professionals, base for HR management in software organizations", 12th International Conference on Informatics in Economy (IE 2013), Education, Research and business Technologies, Bucharest, April 2013
6. Bodea C. N, E-A. Toader, "Project management competency assessment methods for IT professionals", 13th International Conference on Informatics in Economy (IE 2014), Education, Research and business Technologies, Bucharest, May 2014
7. Brown, M.G., 1996. Keeping Score: Using the Right Metrics to Drive World-class Performance. Productivity, Inc., Portland

8. Güngör, P. (2011). The Relationship between Reward Management System and. Procedia Social and Behavioral Sciences, 1510

9. International Project Management Association, ICB - IPMA Competence Baseline, Version 3.0, Netherlands, 2006, ISBN: 0-9553213-0-1

10. Li-Yin Shen, Wei-Sheng Lu, Hong Yao, De-Hu Wu, A computer-based scoring method for measuring the environmental performance of construction activities, Automation in Construction 14 (2005) 297– 309

11. Macky,K.,& Johnson, G. (2000).The strategic Management of Human Resources in New Zealand. Auckland, New Zealand: Irwin/McGraw-Hill

12. Masron, T.A., Ahmad Z. & Marimuthu, M (2011) Positioning KIPs in the Performance of Universities. Universiti Sains Malaysia

13. Paquette, G. (2010) Visual Knowledge Modeling for Semantic Web Technologies.Models and Ontologies, IGI Global, USA, 2010, pp.93-175

14. Tsai YC, Cheng YT., Analyzing key performance indicators (KPIs) for E-commerce and Internet marketing of elderly products: a review, Archives of Gerontology and Geriatrics 55 (2012) 126–132

15. Uren S., E. Griffiths, Environment Management in Construction, Construction Industry Research and Information Association, 2000.

16. Wathey D., M. O'Reilly, ISO 14031: A Practical to Developing Environment Performance Indicators for Your Business, The Stationary Office Limited, 2000.

17. Zairi, M., 1994. Benchmarking the best tool for measuring competitiveness. Benchmarking Int. J. 1, 11–24.

18. Yeung, J.F.Y., Chan, A.P.C., Chan, D.W.M., 2009. A computerized model for measuring and benchmarking the partnering performance of construction projects. Automat. Construct. 18, 1099–1113.