

## ENTROPY IN COMPETENCE MANAGEMENT OF STAFF TEAMS

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**Abstract:** The assessment of employees' competence is the most important and essential information for decision-making process of companies. As observations show, despite abundant stock of data and available competency assessment methods, managers receive few useful information needed for human resource management. In this study is proposed to use the informative entropy method, which measures the amount of information contained in particular competencies. The described method can be used for assessment of the competency resources possessed at the level of staff team. This method mainly allows to determine distribution of competence in the structure of the group, assess adjustment of real resource to needs, and to locate competency deficits.

**Keywords:** competence management, managing teams of employees, entropy

### Introduction

The value of the company depends on the possessed resources and efficient use of them [1] on which a substantial influence have the competences that are at the disposal of the company. Thus, the assessment of competence of employees is the most important and essential information for decision-making process of companies.

Competency - based management, is therefore an important element of personnel policy. However, in many companies the feature of human resource management systems is incoherence in the undertaken activities. Lack of harmony mainly among systems, such as: recruitment, training and remuneration policy - results in the inability of an effective and sustainable management in the given area. The survey of the literature and own observations indicate that despite the large effort involved in human resource management, there is little reliable information used in management systems of companies. This is because the organizational units in enterprises communicate with each other to a small extent and most of the information are gathered for their own use. All the more so *the use of competencies inherent in employees, is one of the most important tasks in the enterprise, and the only professional group that has a direct impact on the development of the financial result of companies are managers at various levels. As shown by studies carried out in several Polish companies - errors in the management of human resources are the primary impediment to achieving competitiveness* [2].

One of the elements of the company's competitiveness is its adaptability, depending on the ability of adjustment of human resources to current operational needs[3]. In today's era of economic progress, when changes occur surprisingly quickly, managers should use the support tools to obtain a competitive advantage.

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Without such solutions, human resource management is an intuitive action, often generating excessive costs and waste of time [4].

Competency approach is a useful concept of managing human resources due to the fact that it allows the internal integration of the many activities in the area [5]. Competencies are the bridge, which integrates databases in an enterprise, which is why they are so important for human resource management system. Particular increase of interest in competence category in management sciences falls on the seventies of the twentieth century, mainly due to D. McClelland (1973) [6], who first demonstrated with his research that rapidly changing economy not only forces continuous verification of knowledge and skills but also developing the appropriate competencies that have a material impact on the ability to use them. D. McClelland decided to check the extent to which scientific achievements and high IQ may be linked to success in career. The results received, proved that it was not so called *model students* that have the best chance of having a satisfactory career. This was the first documented evidence that in addition to technical skills and general and professional knowledge, one should pay attention to the existence of additional factors, which have been identified as competence, and their key role in shaping the unit.

Competencies are essential to success, both in personal and professional life. These include: the specific skills and abilities, knowledge, experience, attitudes, values, beliefs, personality features. They determine the ability to exploit the potential of individuals, actuate their development and determines their uniqueness. If competencies management ought to be effective, it must be shaped as comprehensively as possible [7]. It is especially difficult, since it must take into account: the rapid development of technology and changes in the external environment - which are changing so quickly that it is difficult to predict exactly which tasks will perform employees of many department. This problem initially mainly concerned information technology department (IT), but it soon turned out that the electronic revolution has forced changes in tasks, virtually on all positions. In addition, customer expectations, stimulated by competition in the market are changing rapidly, resulting in the need to seek solutions to giving flexibility to human behavior.

This all contributes to the fact that companies are faced with the problem of the lack of appropriate specialists at the given time. The problem is not solved by refreshing training of company's own staff, because needs occur most frequently as a result of *business setback*. Training plans are most often already established at that time and usually do not include such needs. In addition, process of integration of theoretical knowledge gained in the training with practical skills is long, and the outcome uncertain. An additional difficulty in the management of human resources is that the methods used are focused on measuring the competence of a particular employee. Individual assessment is subject to considerable error of subjectivity on the part of the assessing person, except that it usually causes a number of tensions on the part of employees. This is due to aversion to any kind of change and

exposing own intellectual and personality characteristics. What's more, the work of a single person is not equivalent in time. Its performance is affected by constant stream of emotions and observations that affect the overall motivation of the employee. Employee's performance at any time depends on the combination of these factors triggered by the current events in the work. However, given the fact that in companies more and more implemented activities have the nature of collective action, it is only the structure of the group that triggers conditions for disclosure of the competence of the members, for the entire group. In addition, an employee in a confrontation with another employee behaves quite differently than in isolation, and therefore workforce competencies have a higher utility value understood as the value of their potential.

Modern enterprises, in order to meet the challenges of the market must have tools that in a relatively simple design will allow managers to design employee teams, capable of performing selected targets. This paper presents a new approach to the problem of measuring workers' competencies. This new perspective asks to see workers in a systemic approach and on this basis to conclude about the behavior of work teams and not about individuals. This view largely supports the process of human resource management in the enterprise.

The key concept applied to processing empirical data in the tool presented in work is entropy based on the statement by C.E. Shannon (1916-2001). The term *entropy* in information theory was borrowed from physics, where it means the measure of the disorder in the physical system. Equilibrium state of maximum entropy, is the state most probable, while the state with the lowest entropy - the least probable. Therefore, in terms of the thermodynamics, entropy can also be expressed in the language of the respective probabilities. The concept of entropy extends well beyond the strictly physical sense and in addition to thermodynamics, includes both computer science and information theory. Entropy by its relationship to information is of paramount importance in today's world, because our life is in the end a continuous transmission, receiving, recording, organization, storage, processing of different messages and the information contained therein. Therefore, the primary C. Shannon's achievement was to formulate measure of the amount of information in the given message. Information theory does not answer the question what is the information, but is interested in measuring the its quantity. And this property is interesting from the point of view of the competence of the Human Resources analysis .

In our case, we are more interested in how much information is contained in the message, determining the competence of the staff team than a single worker competence. Therefore the entropy is widely used in a variety of scientific disciplines. As a measure of the degree of disorder, or alternatively indeterminacy, has been used also in sociometric research, which determines the distribution of choices in the group. If the disorder is maximum, ie each person receives the same number of choices, the entropy is maximum, if, however, the choices are hierarchical, and we are interested in the scale of the hierarchy, we obtain a lower

value of entropy. Entropy is therefore also applicable to the study of the structure of social groups [8]. Treating the point evaluation of employees' competencies as a special communication system with the ability to transfer information, an attempt is made to use properties of entropy to examine and assess the distribution of competence, in teams of workers. Entropy as a measure of information is used as a tool to transpose the quality results into quantitative results. It is assumed that thanks to this method it can be assessed - whether the resources and skills possessed by them - will be at the disposal of a company, have the right structure. With the kind of knowledge, managers can better and more effectively, through appropriate management, direct subordinate employees reaching their objectives.

### **Entropy in the analysis of competence**

In economic analyzes probabilistic methods are often used. This option also includes the analysis of information: its value can be estimated on the same principles. The value of the particular information can be treated as the average value of all possible values, resulting from potentially possible acts of utilization, weighted by the probability of occurrence of each of such a fact. Entropy as a measure of information is a tool for the translation of the quality results into quantitative ones, and most importantly - is a tool for unordered data processing. Hence the usefulness of this measure when examining the data contained in sheets of competence, where the amount of data that is relevant depends on many factors. Measurement of competence by the entropy test answers the question - if employee competency resources being at the disposal of a company, have the right structure, are optimally used in the desired areas and how this information will be translated into a useful management tools.

Method presented in this paper is a qualitative and quantitative method. The described method can be used as organization's internal tool and can be integrated with the management information system. As the tool is suitable for implementation in any type of business. However, the greatest benefit can be achieved in large organizations or companies where there is a high turnover of staff, it is often needed to reorganize the internal structure of the organization, or under the pressure of time comes to make operational decisions. This method can also be used in the public administration and municipal enterprises. In companies where the presence of trade unions usually puts resistance against the introduction of any changes and consequently manager must skillfully manage human resources at its disposal. This method, in principle, has no justification in micro enterprises, because managers are usually the owners who are fully aware of all the employees, also a small number of employees makes the number of combinations of workers settings in teams is too small. Integral issue of the process related to the team design is preparing reference model containing the preferred intensity of competence, in accordance with the needs reported by the manager. The team design process begins with a setting up appropriate subset (eg, teams of 3 - or 2 - person). Number

of employees settings combinations in the team results from the so-called *Newton's symbol* formula:

$$\binom{n}{k} = \frac{n!}{k! \cdot (n - k)!} \quad (1)$$

The Newton's symbol can specify the number of all possible combinations of created k-element sets from the set of n-elements. In this paper a subset of k-element is the size of a task force that was created from the available set of workers described as n-element set. Set of n-element is the total labor supply. These are employees available to manager, the number of which is slowly variable in time, and from which k-element task forces are dynamically created, most often k = 2 and k = 3, which means teams of 2 - or 3.

Entropy as a measure of inequality is a function of some data sequence, which can be expressed as the sum of the probabilities' products concerning occurrences of particular character and the number of its in the data, where p (i) is the probability of occurrence of the character (i) in a given set of data, and the number (i) is the number of its occurrences in the sequence. Discovering knowledge associated with the proposed concept consist of measuring the irregularity of distribution of competences in a group of employees. Therefore we are interested in numerical representation of the degree of irregularity of the distribution of each of competence. Inequality coefficient is calculated according to the formula:

$$\text{Inequality coefficient} = \frac{H}{H_{\max}} \quad (2)$$

Using the calculated inequality coefficient value, referenced to the range <0, 1> we correct it with to the average value of the competence according to the formula:

$$K_j = \bar{K}_j \cdot e(K_j) \quad (3)$$

where:

$\bar{K}_{\text{average}}$  - is the average value of competence

$e_{(j)}$  - the coefficient of inequality

This way you can determine the corrected value of competence. Then calculate the Euclidean norm for the team according to the formula:

$$K_{\text{corr}} = \sqrt{\sum_{j=1}^n K_j^2} \quad (4)$$

where:

$K_{\text{corr}}$  - corrected value of the competence

The corrected estimations of entropy, can be viewed as the probability distribution of competence K (i). The value of this should then be compared with the corrected

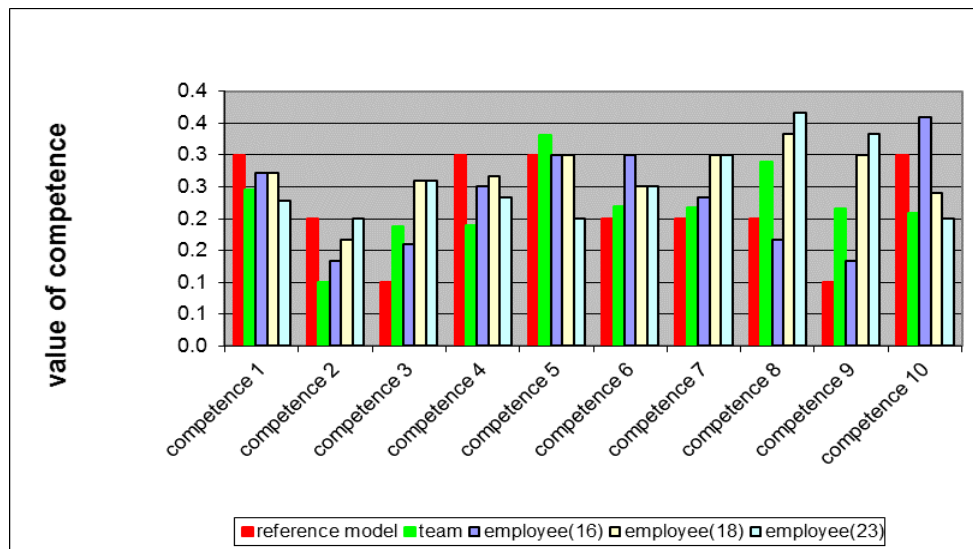
values of the competence of the reference model. The final stage of the calculation is to looking for appropriate team from a set for which the value of normalization index has taken the desired value, so that the degree of adjustment to the reference model is the most similar. In other words, the key to choose the most effective combination is a value of the index associated with the matching degree of the given configuration of workers (overvaluation - undervaluation) to this index of model. We make the best adjustment by comparing the values of Euclidean norm index calculated respectively for the reference model and the proposed team. Matching index is given by:

$$\text{matching index} = \frac{\text{Euclidean norm} - \text{reference Euclidean norm}}{\text{reference Euclidean norm}} \times 100\% \quad (5)$$

where:

*Euclidean norm* –is the square of the adjusted value of the competence

Analyzing the Formula 5. - matching is defined as the absolute value, which should oscillate around the value "0". A value of "0" indicates a perfect relative adjustment of a team to the reference model. Positive values indicate overestimation (surplus of competence value over the reference model), and negative values indicate underestimation.



**Figure 1. Synthetic summary of estimations**

*source: Author's elaboration*

The Figure 1 presents a graphical representation of the competencies for three exemplary employees, presented in the context of the whole team and to the

reference model. Such an approach to competence allows the analysis in the field of eg. training needs, it can also be useful to measure their effectiveness.

### Summary

Described in this paper method of measuring the competence aims at improving the activities in the field of HR( Human Resources). The measurement procedure has static nature. Enhanced with the possibility of computer data processing it can be the source material for further research on the introduction of new elements of dynamic nature, ie decreasing in time eg. employee motivation.

*Optimal use of the employees' potential is the primary way to success[9].*

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## ENTROPIA W ZARZĄDZANIU KOMPETENCJAMI ZESPOŁÓW PRACOWNICZYCH

**Streszczenie:** Ocena kompetencji pracowników należy do najważniejszych i najistotniejszych informacji w procesie decyzyjnym przedsiębiorstwa. Z obserwacji wynika, że mimo bogatego zbioru danych i dostępnych metod oceny kompetencji menedżerowie otrzymują niewiele przydatnych informacji dla potrzeb zarządzania zasobami ludzkimi. W niniejszej pracy proponuje się wykorzystanie metody entropii informacyjnej - która stanowi miarę ilości informacji zawartej w poszczególnych kompetencjach. Prezentowana metoda może posłużyć do oceny posiadanych zasobów kompetencyjnych na poziomie zespołu pracowniczego. Pozwala m.in. wyznaczać rozkład kompetencji w strukturze grupy, oceniać dopasowanie rzeczywistego zasobu do potrzeb, lokalizować deficyty kompetencyjne.

**Słowa kluczowe:** zarządzanie kompetencjami, zarządzanie zespołami pracowniczymi, entropia

### 安特羅皮亞管理單位僱員的能力

**摘要：**評估員工的能力是最重要的和必要的信息，為決策企業。觀測結果顯示，儘管一組豐富的數據和方法來評估經營者的能力得到一點有用的信息，為人力資源管理。在本文中，我們提出了一種方法，利用信息熵——這是衡量個人能力中包含的信息量。該方法可用於評估可用的資源，員工隊伍的能力水平。它允許他人之間組結構確定的權限分配，評估適合真正的資源，能力赤字的需求。