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Principles of Quality and ISO 14001 System Implementation in the Knowledge-Based Economy

INTRODUCTION

Knowledge-based economy can be defined from a microeconomic perspective as an economy in which all enterprises perceive knowledge as a fundamental productive asset, and actively manage and utilise internal and external knowledge resources. Knowledge-based economy can be defined from a macroeconomic perspective as an economy characterised by a fast development of economic sectors that are related to information processing and science – high technology industries, information society services and technologies, etc. Finally, knowledge-based economy can be defined from a systemic perspective as an economy related to the new civilisation era of informational or networked civilization. This includes two previous definitions, but also other, e.g. civilisation aspects: the dematerialization of work and a fast change of professions in informational civilisation, the importance and change of character of education systems, etc. [Wierzbicki, 2007, p. 620].

One of the determinants of information or knowledge society is continual improvement of products and processes efficiency, so that the final outcome could meet the recipients expectations to a great extent.

THE ROLE OF MANAGEMENT SYSTEMS IN THE KNOWLEDGE-BASED ECONOMY

Quality improvement is inherently a learning and knowledge-based activity that emphasizes learning and knowledge creation [Choo, Linderman, Schroeder, 2007, p. 918]. Among the tools of obtaining organisation strategic objectives, including the afore mentioned continual improvement, there are formalised management systems, i. e. quality management system and environmental one. They are based on similar premises. What leads to the organisation development is the continual improvement of products quality and minimizing the negative influence on the natural environment. Attaining the above aims is possible through better effectiveness of the processes, thanks to the application of the knowledge accumulated in the organisation. The principles of qual-

ity management provide an interesting perspective pertaining to the core of the creative knowledge and its processes, carried out and improved in organisations [Winter, 1995, p. 461]. Over the last decade, ISO 9000 standards have increased their impact on organizations by proposing a way to create a competitive advantage and to manage the quality systems. As they include documentation requirements, these standards are also related to the accumulation of knowledge within the firm. They promote knowledge codification and formalization [Bénézech et al., 2001, p. 1405]. ISO 9000 norms are based on eight principles of quality management, the application of which facilitates obtaining the goals. The principles are as follows [Sokołowicz, Srzednicki, 2006, p. 5–6]:

- Customer-Focused Organization – Organizations depend on their customers and therefore should understand current and future customer needs, meet customer requirements and strive to exceed customer expectations.
- Leadership – Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.
- Involvement of People – People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit,
- Process Approach – A desired result is achieved more efficiently when related resources and activities are managed as a process.
- System Approach to Management – Identifying, understanding and managing a system of interrelated processes for a given objective improves the organization's effectiveness and efficiency
- Continual Improvement – Continual improvement should be a permanent objective of the organization.
- Factual Approach to Decision Making – Effective decisions are based on the analysis of data and information,
- Mutually Beneficial Supplier Relationships – An organization and its suppliers are interdependent, and a mutually beneficial relationship enhances the ability of both to create value.

The application of the afore mentioned principles makes it easier to obtain the quality goals as well as strategic ones, such as environmental objectives of the organization.

PRINCIPLES OF QUALITY AND ISO 14001 ADOPTION IN PODKARPACKIE PROVINCE ENTERPRISES

More and more enterprises using the quality management system extend it by further systems such as the environmental management system (EMS), which is most often applied. It can be assumed that among Polish companies applying ISO

9001 or any other system, 4/5 of the cases constitute the EMS [Salerno-Kochan, 2004, p. 85–86]. Consequently, a new need has emerged in organizations, namely to integrate these systems in a single, and therefore ‘‘integrated management system’’ (IMS) [Karapetrovic, Casadesús, 2009, p. 533]. Similar bases for the two systems facilitate extending the system in progress by further areas of business activity.

The research conducted among 36 Podkarpackie province enterprises shows that 34 of them also had the quality management system applied. The enterprises which were the first to implement the quality management system had experience connected with management systems implementation obtained during the adoption of the environmental management system. When asked whether ISO 9001 facilitated the implementation of EMS, 96,15% said “yes”, and only one enterprise said “no”. 80% of the former confirmed that it was a great help, the others admitted it was just average.

In order to examine the most useful principles of quality in ISO 14001 system adoption, the organizations were asked to assess the principles. Their answers were presented on a scale with the values from 0 to 5. Zero meant that the principle wasn’t useful at all and five that the principle was very useful. The average grade for the assessment of quality principles regarding their usefulness is presented in Table 1.

Table 1. The average grade of the principles of quality, τ-Kendall’s coefficient of correlation and the level of test probability

Principles of Quality	Mean	Size		Area of business activity		Export sales	
		tau-Kendall’s	p	tau-Kendall’s	p	tau-Kendall’s	p
Customer-Focused Organisation	3,76	0.0167	0.9069	0.1780	0.2122	0.1483	0.3341
Leadership	3,96	0.1375	0.3353	-0.1899	0.1834	-0.2426	0.1141
Involvement of People	4,08	-0.0197	0.8901	-0.2029	0.1552	-0.2547[b]	0.0971
Process Approach	3,88	0.1490	0.2966	-0.0131	0.9269	0.0978	0.5242
System Approach to Management	4,16	0.2955[a]	0.0384	-0.0203	0.8871	0.2632[b]	0.0864
Continual Improvement	4,60	0.2475[b]	0.0828	0.1886	0.1864	0.2081	0.1752
Factual Approach to Decision Making	3,84	-0.1123	0.4314	-0.1081	0.4490	0.0696	0.6504
Mutually Beneficial Supplier Relationships	3,68	0.1895	0.1842	0.0131	0.9267	-0.0167	0.9134

[a] 0.05 level, [b] 0.1 level.

Source: own calculation.

The enterprises found the principle of Continual Improvement to be most useful (4,60). Another management principle useful for ISO 14001 implementation was the System Approach to Management (4.16). Involvement of People was also valued (4.08). Next management principles were as follows: Leadership (3,96), Process Approach (3,88), Factual Approach to Decision Making (3,84), Customer-Focused Organization (3,76) and Mutually Beneficial Supplier Relationships (3,68).

THE CORRELATION BETWEEN THE QUALITY PRINCIPLES AND THE ENTERPRISES' FEATURES

The next question asked was whether there is a connection between the assessment of the eight principles and some selected characteristics of the enterprises. The answer was provided by the analysis of τ-Kendall's correlation. The coefficients of correlation including their significance level of test probability is shown in Table 1. On the level of 0.05, what was significant was the coefficient between the size of the enterprise and the importance of the System Approach to Management (0.30). Its positive value means that the system approach was more important for big enterprises than the smaller ones.

On the level of 0.1 statistically significant was the coefficient of correlation between the Continual Improvement principle and the size of the enterprises. Its value (0.25) means that the Continual Improvement was more valuable for the bigger enterprises than for small or medium ones. At that level statistically significant were also correlations between principles: Involvement of People, System Approach to Management and the export share of the subjects. The values of τ-Kendall's coefficient were respectively: -0.25 and 0.26. The first meant that the Involvement of People was less important for the companies with the higher export share. The second one that the System Approach to Management was more important for exporters. There weren't any statistically significant correlations between the principles of quality and the area of business activity. Negative sign of the coefficient between the Involvement of People principle and the enterprises performance shows that the aforementioned principle was more crucial for small and medium size or local and regional subjects than for big or national and international ones. The fact that those relationships weren't statistically significant makes the generalization on the whole population impossible.

THE CONCORDANCE AMONG THE EXTPERTS' OPINIONS

As the research was based on subjective opinions of the enterprises, the conformity of the opinions was expressed using tau-Kendall's coefficient of concordance [Baumgartner et al., 1999, p. 1525–1526]. The concept of con-

cordance refers to at least three different contexts: voting and decision making, attitude assessment and statistics [Elzinga et al., 2011, p. 2529]. The coefficient of concordance is given by the formula:

$$W = \frac{12S}{n^2(k^3 - k)},$$

where n is a number of experts, k – number of categories, and S is given by:

$$S = \sum_{j=1}^{k}\left(\sum_{i=1}^{n} x_{ij} - \bar{x}\right)^2,$$

since $\bar{x}$ is the average sum of ranks for all categories i.e.:

$$\bar{x} = \frac{1}{k}\sum_{i=1}^{n}\sum_{j=1}^{k} x_{ij}.$$

The coefficient of concordance ranges between 0 and 1, with 1 corresponding to perfect agreement (or concordance) and 0 indicating no agreement or independence of samples. As W increases, there is greater agreement among observers [Grzegorzewski, 2006, p. 315]. Statistical significance of tau-Kendall's coefficient of concordance is measured with the use of chi-square ANOVA statistics [Möttönen, Hüsler, Oja, 2003, p. 107]. Testing the statistical significance of the coefficient of concordance consists in the verification of the zero hypothesis which advocates that studied row of ranks are not related with themselves. We neglect zero hypothesis, if the empirical value of the chi-square statistics is equal or larger than the theoretical value [Cabała, 2010, p. 43]. This marks that the convergence of experts opinion is not accidental, so one can recognize experts team as competent therefore [Cieślak, 2004, p. 170].

Table 2. Statistics of Friedman's test and the value of Kendall's coefficient of concordance

Chi-square ANOVA	N	df	p-value	W
70.9892	8	23	0.0000	0.3697

Source: own calculation.

The value of the coefficient of concordance (0.37) shows that the experts in most cases agreed in their average opinions about the examined principles of quality. Moreover the result of chi-square ANOVA test confirms that the compliance of the experts wasn't accidental (table 2). It allowed to recognize the selected experts team as a competent body.

CONCLUSION

ISO 14001 standard resembles ISO 9001 norm, partly because the revision of ISO 9001 has been inspired by the ISO 14001 standard. Moreover, all the general techniques of ISO 9001 i.e.: policy formulation, objectives, management review, PDCA cycle, manual, description of authority and responsibility, checking, corrective and preventive actions, training, internal and external audits are contained in ISO 14001 standard as well.

The quality management system, having been applied in the examined enterprises, helped those companies remarkably with the adoption of ISO 14001. The examined organizations confirmed that the quality principles were very useful during the adoption of the environmental management system. The principles regarded as most important were: Continual Improvement, System Approach to Management and Involvement of People. The advantages of the System Approach as well as the Continual Improvement were more appreciated by big organizations.

We conclude that the use of quality and environmental management systems are most effective when they provide an organizational background or frame within which individuals are encouraged to undertake inquiries that are integrated with the firm's strategic concerns without these concerns being at all fixed. Such systems are least effective when they externally impose procedures as unmoveable and immutable "blueprints" [Jayawarna, Holt, 2009, p. 775].

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Summary

The article presents a role of the standardized ISO management systems: quality management system as well as environmental management systems in the process of knowledge creation. Both systems help to create codified knowledge in the enterprises. The paper presents the research results conducted in the enterprises of the Podkarpacie province which adopted above mentioned systems. The research results show that the most important for the examined enterprises were the following principles of quality: continual improvement, system approach to management and involvement of people. Using tau-Kendall's coefficient of correlation the relationship between the subjects features and their opinions about the utility of the principles while EMS introducing was examined. Moreover the commitment among the opinions regarding the meaning of ISO 9001 system's principles in the enterprises was measured using the coefficient of concordance.

Zasady zarządzania jakością a wdrażanie systemu ISO 14001 w warunkach gospodarki opartej na wiedzy

Streszczenie

W artykule, na podstawie wyników badań własnych, przedstawiono rolę znormalizowanych systemów zarządzania, tj. systemu zarządzania jakością i systemu zarządzania środowiskowego w procesie kreowania wiedzy w przedsiębiorstwie. Badania przeprowadzono wśród przedsiębiorstw województwa podkarpackiego, które posiadały wdrożone systemy: zarządzania środowiskowego ISO 14001 oraz system zarządzania jakością 9001. Wyniki badań pokazują, że przedsiębiorstwa,

które jako pierwszy wdrożyły system zarządzania jakością korzystały znacząco ze zdobytych doświadczeń we wdrażaniu kolejnego systemu zarządzania. Spośród zasad zarządzania za najbardziej przydatne uznano: ciągłe doskonalenie, systemowe podejście do zarządzania oraz zaangażowanie ludzi. Za pomocą analizy korelacji tau-Kendalla, przeprowadzoną pomiędzy oceną zasad zarządzania jakością a wybranymi cechami badanych podmiotów, wykazano występowanie istotnych statystycznie zależności. Ponieważ wyniki badań oparto na opiniach przedsiębiorstw, to dodatkowo za pomocą współczynnika zbieżności, jak i testu Friedmana zbadano zbieżność opinii przedsiębiorstw dotyczących roli ośmiu zasad zarządzania jakością.