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INTELLIGENT TECHNOLOGIES IN PRODUCTION QUALITY ASSESSMENT

ABSTRACT *In the proposed article, the question of production (service) quality assessment with the use of expert systems concerning the consumer requirements and expectations is under consideration.*

Key-words: *quality, assessment, improvement, expert system, consumers.*

1. INTRODUCTION

Nowadays the problem of quality, its assurance and improvement is of high topicality in all the spheres of human activity. The successful quality management for production and services is one of the main conditions of an enterprise

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PROCEEDINGS OF ELECTROTECHNICAL INSTTITUTE, Issue 249, 2011

competitive ability. The vast development of quality assurance and management methods is tightly connected with the employment of quality assessment qualimetric methods. The qualimetric ratings of production quality indices assist any scientifically substantiated decision making along with the realization of relevant correcting actions aimed at quality improvement.

Although a notion of quality varies in any certain case. A manufacturer evaluates the production due to its own important indices, a consumer bases himself/herself on others, and these criteria do not usually coincide. Even if the producer intends to trace the consumer requirements (by periodic surveys), the gained information is not correct enough as a rule, with a high degree of fuzziness. To solve the problem of converting the got fuzzy information into quantitative indices with the following application to production quality assessment and improvement, the intelligent technologies, in particular, expert systems and fuzzy logic algorithms have proved efficient.

2. RESEARCH ANALYSIS

These days the artificial intelligence-oriented technologies are evolving rapidly. The considerable contribution to this area was made by the professor of University of California Dr. Lotfi A. Zadeh, who developed the main modeling principles of human intelligent activity that became the real breakthrough on the way to a new theory [1]. The present period is notable for the boom in practical involving a fuzzy logic into the numerous fields of science and techniques. Some progress has been achieved in the application of Fuzzy Sets theory to study process and enterprise competitive ability evaluation. However the concept has not found its worthy implementation in the area of standardization, certification and quality management yet [3]. The use of intelligent technologies, in particular, expert systems in production quality management would promote quality and other general enterprise indices improvement, as well as efficient brainstorming based on considering consumer requirements and expectations.

3. CONSTRUCTION OF THE EXPERT SYSTEM FOR PRODUCTION QUALITY ASSESSMENT

The aptness of the expert system (ES) with Fuzzy Logic algorithm application for production quality assessment is grounded in the proposed work.

The tasks set for ES are the following: the diagnostics and monitoring of consumer requirements and expectations (market demands), production quality assessment with regarding consumer requirements, and making control decisions as to production quality improvement. Fuzzy Logic algorithm application enables us to process (analyze) information delivered by consumers and experts using surveys (questioning) as the qualitative features of the natural language (linguistic variables) [2]. ES is supposed to provide the feedback between consumers (market) and production manufacturers.

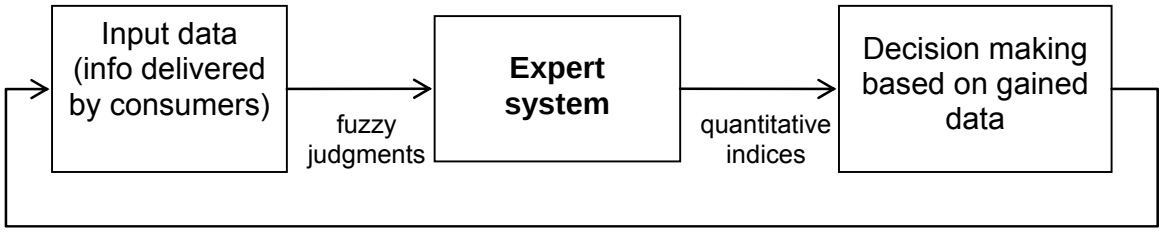

Fig. 1. ES-based decision making scheme

The category of quality is a debatable and complicated notion. Therefore we should consider it as a complex system and correspondently apply a system approach to the quality assessment. The most important properties of all complex systems are a hierarchy structure, the numerousness of the elements and the availability of relations among them. In qualimetry, the quality is considered as a certain hierarchic totality of properties, particularly those that evoke the interest of a consumer. The highest hierarchy level is characterized by the generalized quality index that in turn is rendered by a function of single or group quality indices. An amount of particularization hierarchy-levels could vary and depends both on evaluated object properties and the set qualimetry task. The hierarchy of quality indices should be presented as the inference tree described by the following system:

$$K = f(K_1, K_2, \ldots, K_s),$$
$$K_1 = f_1(K_{11}, K_{12}, \ldots, K_{1r}),$$
$$K_2 = f_2(K_{21}, K_{22}, \ldots, K_{2m}),$$
$$K_s = f_s(K_{s1}, K_{s2}, \ldots, K_{sd}),$$
$$K_{11} = f_1(K_{111}, K_{112}, \ldots, K_{11v}) \text{ etc.},$$

here K is the generalized quality index that corresponds to the highest n-th hierarchy level; K_1, K_2 …K_s are the group quality indices of the (n-1)-th level;

K_{11}, …, K_{1r}, K_{21}, …, K_{2m}, K_{s1}, K_{s2}, …, K_{sd} are the group quality indices of the (n-1)-th level; K_{111}, K_{112}, …, K_{11v} are the group quality indices of the (n-2)-th level.

Any quality index is denoted by a linguistic variable with an appropriate term set. For example, {«very low», «low», «upper-intermediate» «intermediate», «higher-intermediate», «high», «very high»}. The power of all sets, i.e. an amount of used evaluating terms, could be different. The intricate notion of a membership function enables us to formulate each linguistic term as a fuzzy set, presented by a universal set.

A subsystem of ES logic derivation using fuzzy rules converts the input variables (single or group quality indices) into the output (group quality indices or the generalized one) data that consequently are defuzzificated and become quantitative ratings. The method of dynamic membership-function parameters adjusting based on genetic algorithms is suggested being used to improve the ES functioning.

4. CONCLUSIONS

The application of Fuzzy Logic algorithms to ES allows to evaluate the production quality in both cases of the crisp data of single quality indices and faintly structured verbal-symbol data. The improvement of the quality assessment system for production and services with the use of ES would provide to a manufacturer the possibility to foresee the quality of the proposed production, to compare own products with analogous commodities on the market and to realize relevant correcting and preventing means.

5. ACKNOWLEDGEMENTS

This work was granted by the President of Ukraine within the framework of a supporting program for young scientists.

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Manuscript submitted 19.10.2010

TECHNOLOGIE INTELIGENTNE W ZARZĄDZANIU JAKOŚCIĄ PRODUKCJI

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STRESZCZENIE *W artykule opisano zagadnienie zarządzania jakością produkcji (usług) z wykorzystaniem systemu ekspertowego w celu spełnienia wymagań i oczekiwań konsumentów.*

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