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THE HYBRID SYSTEM OF PROGNOISING IN AN ENTERPRISE

Abstract: The dissertation discusses the notion of the hybrid system. It presents the conception of the hybrid system of supporting the construction of economic prognoses in an enterprise. The authors demonstrate two approaches – traditional and innovative. What is more, the paper determines the mode of integrating methods in the given stage of the prognosing process. Finally, it presents the conditions of the implementation of the innovative approach to the proposed hybrid prognosing system.

1. Introduction

The next generation of artificial intelligence systems consists of hybrid systems which are characterised by the combination of various artificial intelligence methods or artificial intelligence methods with heuristic methods, artificial intelligence methods with statistic and econometric methods, artificial intelligence methods with heuristic, statistic and econometric methods with the aim of creating the new quality of these systems as well as limiting the imperfections and disadvantages of single systems [Smolağ 2005, p. 395]. As regards the extent of integration, it is possible to distinguish the following categories of hybrid systems solutions:

- systems functioning separately – various subsystems do not influence one another and double the results aims at increasing the degree of certainty of the obtained result;
- transformation systems – while designing one subsystem another one is used;
- loosely related systems – include several subsystems which communicate with one another with the use of data sets;
- closely related systems – individual subsystems, basing on the qualities typical of a given subsystem, support the functioning of other subsystems;
- completely integrated systems – a combination of the conceptions of various methods, operate on a common, uniform representation of knowledge and data structures.

Single methods and techniques used in the process of constructing the economic prognoses do not guarantee the realisation of the required tasks and expectations. That is why it is advised to construct hybrid systems. In a prognosing hybrid system of an enterprise (PHS) heuristic, statistic, econometric and artificial intelligence methods should be integrated. Owing to this, the possibilities of supporting the process of constructing the prognoses will be expanded [Kiełtyka 2005, p. 253]. The need to construct the PHS is justified with the following premises:

- continuously increasing complexity of the economic phenomena and processes;
- advantages and disadvantages of certain methods which make them effective only in some situations and ineffective in different circumstances;
- combining the advantages of several methods in solving the problems appearing in different stages of the prognosing process;
- combining the knowledge and experience of managers, experts and prognosers.

The basic aim of this study is to present the conception of the prognosing hybrid system of an enterprise and define the conditions determining the range of the implementation of the proposed system.

2. The hybrid system supporting the process of constructing prognoses in an enterprise

The initial stage of the prognosing process is the most essential. On the basis of his own knowledge and experience or with the help of experts the manager makes the quality evaluation of the prognosed phenomenon – decides on the extent of the phenomenon's complexity. If the phenomenon is classified as a simple one, in the following stages it is possible to apply the traditional approach to the prognosing process (table 1) [Dittmann 2003, pp. 185-195]:

- heuristic methods are used by managers in the stage of formulating the prognosing task and defining the prognosing premises as well as in the stage of concluding, verifying and application of the prognosing model;
- statistic methods are used by prognosers to analyse the statistic data and prepare the preliminary prognoses which are then subjectively evaluated by managers.

If the prognosed phenomenon is classified as a complex one, it is advisable to use the artificial intelligence methods in all the stages of the prognosing process (table 2). Even in the stage of formulating the prognosing task managers ought to take advantage of information/knowledge included in the knowledge base (expert system). The knowledge obtained from the expert system in comparison with the knowledge obtained directly from the expert is less likely to be burdened.

In the proposed hybrid system knowledge and experience of managers and prognosers are supported by various methods and techniques used in the process of economic prognosing. In the group of heuristic, statistic and econometric methods the authors point to the methods which are most frequently used in the prognosing

process in enterprises, whereas in the group of artificial intelligence methods – the most widespread fields which qualities predestine them also to the use in the prognosing process.

Table 1. The outline of the prognosing hybrid system of an enterprise – traditional approach

		Type of the phenomenon		
		Simple		
		Heuristic Methods	Statistic and econometric methods	Artificial intelligence methods
Prognosing stages	Formulating the prognosing task	Experts' opinions	-	-
	Defining the prognosing premises	Experts' opinions	-	-
	Statistic processing and the analysis of data	-	The analysis of statistic parameters and hypotheses Methods of estimating the missing data Methods of calibrating the number values Normalisation methods Formal methods of choosing the explanatory variables	-
	The choice of the prognosing method	-	Methods of prognosing the time series Econometric methods Analogue methods Models of leading variables Models of cohort analysis Market tests method	-
	Prognosis construction	The principle of unburdened prediction The principle of the greatest probability The principle of the minimisation of the expected loss		
	The evaluation of the prognosis acceptability	The method of experts' evaluation	Measures of prognoses accuracy ex ante	-
	Prognosis application	Results from the specific aim of the prognosis		
	The evaluation of the prognosis accuracy	The method of experts' evaluation	Measures of prognoses accuracy ex post	-

„-“ no need to use

Source: the author's study.

Table 2. The outline of the prognosing hybrid system of an enterprise – innovative approach

		Type of the phenomenon		
		Complex		
		Heuristic methods	Statistic and econometric methods	Artificial intelligence methods
Prognosing stages	Formulating the prognosing task	Experts' opinions	-	Expert systems
	Defining the prognosing premises	Experts' opinions Questionnaire method	-	Fuzzy logic Expert systems Neural networks (self-organising)
	Statistic processing and analysis of data	Experts' opinions	The analysis of statistic parameters and hypotheses Methods of nominal values conversion Methods of estimating the missing data Methods of calibrating the number values Methods of normalisation Formal methods of choosing the explanatory variables	Neural networks (recurrent, one-way) Genetic algorithms Evolution algorithms Ant systems Swarm algorithms Fuzzy logic
	The choice of the prognosing method	Experts' opinions	Methods of prognosing the time series Econometric methods Logit and probit models Analogue methods Models of leading variables Models of cohort analysis The method of market tests	Neural networks (one-way) Fuzzy logic Expert systems
	Prognosis construction	The principle of unburdened prediction The principle of the greatest probability The principle of minimisation of the expected loss		
	The evaluation of the prognosis acceptability	The method of experts' evaluation	Measures of prognoses accuracy ex ante	Quality measures for testing sets Expert systems
	Prognosis application	Results from the specific aim of the prognosis		
	The evaluation of the prognosis accuracy	The method of experts' evaluation	Measures of prognoses accuracy ex post	Expert systems

„-“ no need to use

Source: the author's study.

The integration of the methods in a given stage of prognosing can be done in one of the following three modes:

- parallel,
- sequential,
- submerging.

In the parallel mode tasks are solved separately (if it is possible) with the use of the methods from specific groups. The generated solutions can be presented in parallel with one another (in the form of results synthesis) or they can take up the correcting role towards one another. In the sequential mode the task is solved in stages, applying the specific methods one at a time. It is impossible to clearly specify the order of particular groups of methods used in the process. If the character of the phenomenon is unknown or it is impossible to find a solution to the analysed problem with the use of standard methods (specialised techniques), it is advisable to use the artificial intelligence methods in the beginning and then statistic, econometric and/or heuristic methods. If the task can be solved with the use of heuristic, statistic and/or econometric methods, the artificial intelligence methods can play the supplementary role, enabling to specify the final solutions. In the submerging mode some methods constitute the sub-methods of other methods, e.g. neural network is one of the sources of knowledge in the knowledge base of an expert system.

Statistic and econometric methods should be typically used in the prognosing process, regardless of the degree of complexity of the analysed phenomenon. They can be an objective point of reference and comparison with other methods, because they base only on the regularities existing in the prognosing data [Dittmann 2003, p. 186].

3. The conditions of the prognosing hybrid system implementation in an enterprise

The complete application of an proposed conception of the prognosing system in an enterprise is first of all determined by:

- the specificity and size of an enterprise (its information needs);
- the knowledge and experience of the decision-making and executive staff regarding their familiarity with the presented methods as well as the ability to use them;
- tools availability (financial barriers).

The application of the heuristic, statistic and econometric methods in the 3 process of constructing the prognoses in an enterprise may be recognised as a norm. In such a case, the approach to the prognosing process is defined as traditional or classical – obviously if the prognosing process is realised in an enterprise. However, the artificial intelligence methods in Polish economic practice, especially in small and medium-size enterprises, are still perceived as abstract [Jędrzejczyk 2006, p. 344]. Such an attitude is caused by many factors. The most important are:

- ignorance of the artificial intelligence methods;
- limited trust to the artificial intelligence methods with regard to their stochastic character;

- the necessity to install a specialised tool software.

The matrix of conditions of the artificial intelligence methods adaptation in the prognosing process in an enterprise is presented in picture 1. The analysis of conditions was made on the basis of the following criteria:

- the frequency of resignation from the construction of prognoses in an enterprise;
- prognoses accuracy;
- availability of the qualified staff;
- availability of tools.

Three areas of conditions were distinguished. The area in which it is possible to use the artificial intelligence methods (white colour), the area in which it is not possible to use the artificial intelligence methods but the obstacles preventing their use can be eliminated in a short time (bright grey colour) and the area in which it is not possible to use the artificial intelligence methods and the obstacles preventing their use can be eliminated in long time (dark grey colour).

4. Conclusion

The method base in the prognosing system of an enterprise should include these methods which can support the realisation of all the stages of the prognosing process. Since the economic phenomena analysed on the level of an enterprise are becoming increasingly complex, the dissertation points to the necessity of applying the artificial intelligence methods in the prognosing process. They ought to be used together with statistic, econometric and heuristic methods which are typically applied. It is assumed that there is a possibility and need to integrate the heuristic, statistic, econometric and artificial intelligence methods in the prognosing process, both horizontally (in a given stage) and vertically (in the following stages).

What is more, in the study the authors presented the conception of constructing the prognosing hybrid system of an enterprise (PHS). In this system statistic, heuristic and econometric methods are integrated with the artificial intelligence methods in prognosing tasks on the level of an enterprise. The realisation of the process of prognoses construction with the use of the PHS aims at receiving the prognoses of the greatest accuracy.

The conditions of the artificial intelligence methods adaptation in the prognosing process in an enterprise are also analysed in the above study. As a result, three areas of conditions were distinguished:

- the area in which the use of artificial intelligence methods is possible;
- the area in which the use of artificial intelligence methods is impossible but the obstacles preventing their use can be eliminated in a short time;
- the area in which the use of artificial intelligence methods is impossible and the obstacles preventing their use can be eliminated in a long time.

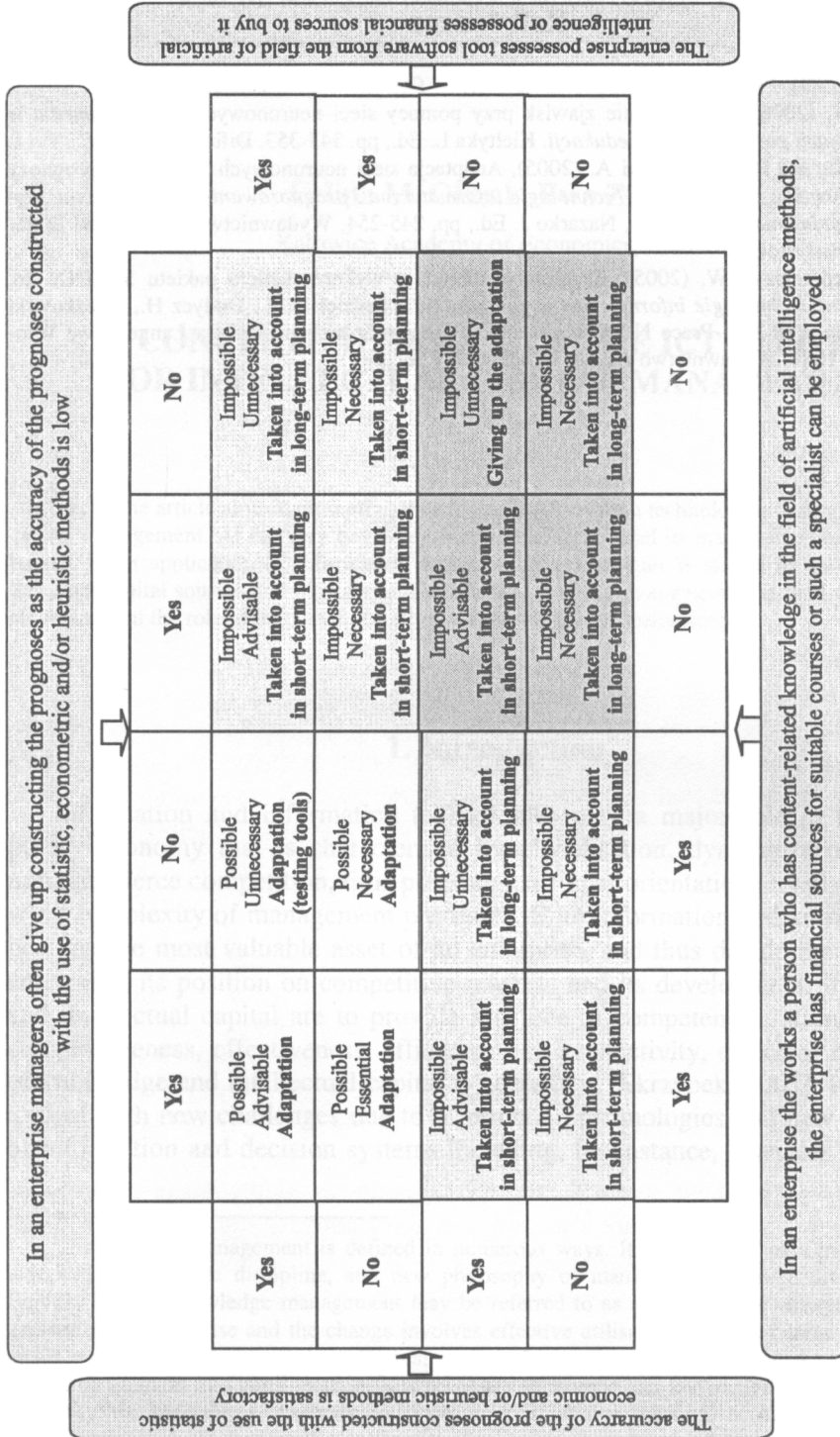


Figure 1. The matrix of conditions of artificial intelligence methods adaptation in a prognosing process in an enterprise
 Source: the author's study.

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