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ADAPTATION OF INDUSTRIAL ENTERPRISES TO THE MODERN CONDITIONS OF THE POST-INDUSTRIAL SOCIETY

АДАПТАЦІЯ ПРОМИСЛОВИХ ПІДПРИЄМСТВ ДО СУЧАСНИХ УМОВ ПОСТІНДУСТРІАЛЬНОГО СУСПІЛЬСТВА

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Ілляшенко Н.С. Адаптація промислових підприємств до сучасних умов постіндустріального суспільства. Науково-методична стаття.

В статті показано, що основою економічного зростання для України має стати інноваційний розвиток. А саме розвиток науки з метою появи нових технологічних інновацій. Доказами на користь такого твердження є практика використання теорії постіндустріального суспільства. В роботі запропоновано теоретико-методичний підхід до адаптації промислових підприємств до сучасних умов господарювання шляхом прогнозування напрямів інноваційного розвитку. Даний підхід базується на поєднанні трендвотчінгового підходу визначення тенденцій середньо- та довгострокового розвитку, кластерного методу угрупування виявлених напрямів та їх моделювання. Проведено практичну апробацію запропонованого підходу на прикладі ТОВ «Турбомаш».

Ключові слова: промислові підприємства, інноваційний розвиток, адаптація, прогнозування, моделювання

Illiashenko N.S. Adaptation of industrial enterprises to the modern conditions of the post-industrial society. Scientific and methodical article.

The article shows that the basis of economic growth for Ukraine should be innovation development. Namely, the development of science in order to bring new technological innovations. Evidence in favor of such a statement is the practice of using the theory of post-industrial society. The theoretical and methodical approach to the adaptation of industrial enterprises to the modern conditions of management by forecasting directions of innovative development is offered in the work. This approach is based on a combination of the trendwatching approach to determining the trends of average- and long-term development, the cluster method of grouping the identified trends and their modeling. The practical testing of the proposed approach is carried out on the example of the domestic machine-building enterprise.

Keywords: industrial enterprises, innovative development, adaptation, forecasting, modeling

Rapid development of new technologies, great science impact on the enterprises activity, orientation to the social and economic development, competition increase, speeding up cycle in introduction of the new goods and service to market are all factors, which influence the enterprise activity. Under changeable conditions in the environment native companies need to introduce those fields in the development, which bring their activity to the qualitatively new level, reveal their competitive advantages and level disadvantages, and also find wide market opportunities and outline threatens to be avoided. Such enterprise activity is possible only based on the efforts complex grouping concerning creation and introduction of innovations. In order to increase efficiency of this process it is necessary to organize innovative activity. Therefore average- and long-term prognostication is formula to create strategy and tactics for actions, which will have no disadvantages while introducingthem. In order to build efficient functioning of the innovative system at the industrial enterprise and to increase itscompetitiveness, special attention is paid to innovative activity prognostication and perspective directions in the development.

Analysis of recent researches and publications

Questions to prognosticate innovative activity are urgent and are solved by the following native and foreign scientists: O.A. Bilovodska [1], O.I. Volkov [22], P. Drucker [3], T.K. Kvasha [5], A.P. Kosenko [7], N.V. Krasnokutska [8], O.Ye. Kuzmin [9], E. Rogers [14], N.I. Chukhray [18], J. Shumpeter [20] etc. However most works deals with approaches, based on the principles of processes and phenomena retrospective development analysis and building models of their further development. Nowadays the Ukrainian industrial enterprises feel impact of those phenomena in environment and factors, which impact them, which are only formed and create perspective tendencies in average- and long-term periods. They determine main direction in development either for concrete enterprise, or for industrial enterprise at a whole. Scientific directions, which allow to prognosticate social and economic processes and

phenomena, forming tendencies of the future actions development, is foresight, trend watching, trend hunting and trend setting. The mentioned fields are studied today by the following native and foreign scientists: A. Carriero [21], I.O. Kirnos [6], I.A. Panchenko [13], L.I. Fedulova [17] and others. However almost everyone observe state activity or separate good or brend as prognosticating object.

The aim of the article is development theoretic and methodic grounds to prognosticate innovative development at the industrial enterprise level, based on realization approach concerning information about tendencies.

The main part

Maximization of the effect and efficiency of innovative activity realization at the industrial enterprise is provided owing to comprehensive study of the current situation, future situation prognosticating in the actions development, clean plan of actions and its keeping. Prognostication is investigation field, which coordinates future development vectors, and is base for choice of the most optimal variants to run business at industrial enterprises [19]. Approbation of the study is carried out at machine building enterprise LLC "Turbomach" (Sumy), founded in May 1999 and is one of the most leading scientific and producing enterprises in Sumy Region in Ukraine [12]. Company deals with repair and modernization of pumping and compressor equipment for chemical, petrochemical branches, power industry and metallurgy. Study of prognostication methods [15] ables to choose and unite those methods for prognostication of the innovative development perspective fields (PIDPF) at the industrial enterprise, which allow to arrive at the innovative development perspective fields and to model future vectors in development from the perspectiveness view, based on the qualitative information about perspective tendencies nowadays and their quantitative estimation. The author's investigated methodic apparatus of PIDPF [16] foresees complicated process to build prognostications, consisted of logically built stages. The first step to conduct PIDPF is retrospective and current estimation of the enterprise activity, main fields in development.

The conducted coefficient analysis of the financial accounting in LLC "Turbomach" activity proves negative changes in enterprise activity.

Having conducted estimation of the enterprise inside state with purpose to argue PIDPF, the next step is to evaluate enterprise market positions, based on SWOT analysis, which is one of methods to present graphically the enterprise activity [10].

Next step to evaluate enterprise is to diagnose its marketing aspects, particularly, SWOT analysis.

On the basis of comparing data, received in SWOT-table, one can conclude, that strong sides in LLC "Turbomach" activity are qualitative production, modern equipment and high image, and the wickest include wick marketing strategy, slow introduction of new production and high operational expenses.

The following stage to realize methodic approach of PIDPF at the industrial enterprise is tendencies trend watching [11].

Tab. 1. represents stages to conduct trend watching analysis in the system PIDPF, next step is to set searching parameters for tendencies distinguish.

LLC "Turbomach" is producing enterprise, and its main direction is production manufacturing. Considering main tasks for PIDPF, it is reasonably to distinguish threemain criteria, by which tendencies choice will be conducted in trend watching research, particularly:

— orientation to main (producing) activity of the industrial enterprise;
— orientation to the innovative way in development;
orientation to keep the set aspects of market relations.

Table 1. Stages to conduct trend watching analysis in the PIDPF system

№ PIDPF stage	Stage-by-stage steps	Detalization of the stage-by-stage steps
III stage of the prognostication processes in perspective directions of the innovative development at the industrial enterprise	3.1 Searching parameters to distinguish tendencies, peculiar for enterprise	3.1.1. Determination of the enterprise 3.1.2. Determination of the enterprise branch and allied ones 3.1.3. Determination of the geographical zone where enterprise is located
	3.2 Searching and distinguishing of processes and phenomena and their checking for surety	3.2.1.Search of processes and phenomena by established parameters, which have novelty 3.2.2. Generalization of processes and phenomena by homogeneity test. Tendencies formation 3.2.3. Check for increasing tendency
	3.3 Check of tendencies for innovativeness	3.3.1. Check of tendencies for corresponding to innovativeness main features: novelty, usefulness for consumption and technical ability to be implemented
	3.4 Choice of tendencies from the perceptiveness	3.4.1. Determination of tendencies extension degree 3.4.2. Choice of the most perspective tendencies, based on the E.Roger's diffusive model

Source: own elaboration

The given criteria give opportunity to distinguish alternative variants of tendencies in social and economic processes and phenomena, which are formed and continue to be formed in society.

According to the author's approach to choose tendencies within PIDPF it is necessary to conduct by the criteria of tendency, innovativeness and perspectiveness.

As a result of trend watching analysis at LLC "Turbomach" are generated and selected by tendency, innovativeness and perspectiveness criteria 50 perspective tendencies, which are base for further analysis and forming of innovative development perspective fields (IDPF) at the analyzed industrial enterprise.

According to author's approach of the methodic PIDPF apparatus, next stage after trend watching is perspective tendencies clustering [16] and IDPF formation. This process provides to carry out consequent steps. In order to estimate tendencies quantitatively and to build income data to conduct cluster analysis of tendencies we conduct calculation of tendencies extension speed by formula (1):

$$S = \frac{DTE}{t}, \quad (1)$$

where S – speed of tendency extension, %/year;

DTE – degree of tendency extension (formula (2));

t – period of the tendency existing, years.

$$DTE = \frac{\sum_{i=1}^{n} \Delta RNTS_i}{PPNTE} \cdot 100\%, \quad (2)$$

where DTE – degree of the tendency extension, %;

ΔRNTSi – growth of the tendency showing real number in i-th period, unit of showings;

PPNTE – potentially possible number of tendency extension cases, unit of showings;

i – ordinal number of the tendency existing period year;

n – number of years in tendency existing period.

Having calculated tendencies extension speeds it is reasonably to estimate factors constituents, which assist tendency estension speed, by methodic, represented in fig. 1.

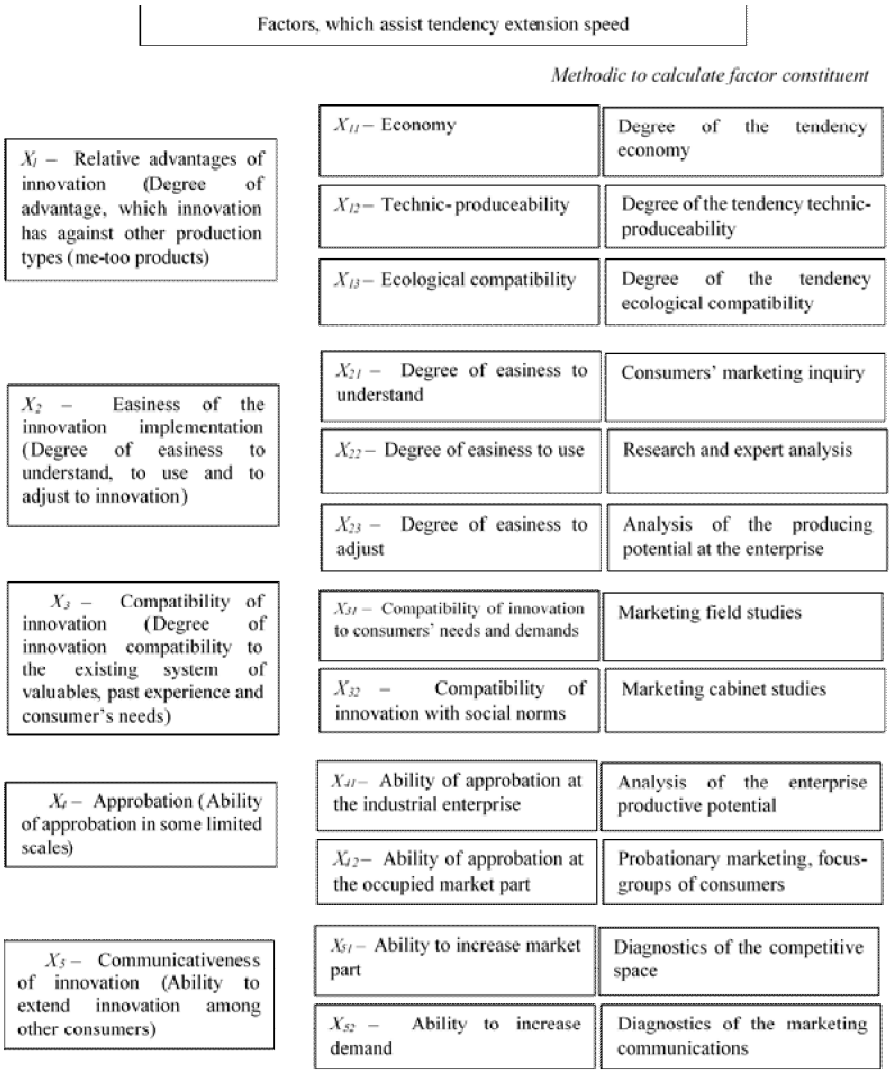

Fig. 1. Factors, which assist tendency extension speed
Source: own elaboration

According to factors constituents and tendencies extension speed estimation, final data are incoming data to conduct clustering analysis of the perspective tendencies. Clustering analysis of tendencies is conducted with purpose to range them by groups, which will form base for IDPF. Since the factors calculation, providing clustering analysis, is massive process, it is reasonably to use special computer programs. Program "IBM SPSS Statistics 18" was chosen for clustering analysis. Tree-like clustering method was chosen for clustering analysis; distance between objects – Euclidean distance; clustering strategy – intergroup relations.

Due to the calculations, conducted in "IBM SPSS Statistics 18", results of the clustering analysis present matrix of calculated distances closeness between objects by the chosen methodic, table of agglomeration steps i.e. regular steps of tendencies uniting into clusters; tanble, which represents belonging of tendencies into clusters and dendrogram of tendencies uniting into clusters.

After clustering analysis one investigates conclusions, that it is reasonably to distinguish tendencies into the following six clusters, which depend on factors components. Owing to tendencies specific, which form cluster, it is reasonably to distinguish the only one feature [4], which unites tendencies and formation IDPF code.

Constituents of factors, which mostly impact the cluster forming, are selected by the following criterion: if value of factor impact on all tendencies, included to cluster, are larger than average in diapason 0.5-1, the constituent of the factor impact has the largest influence on the formed IDPF extension speed. Tab. 2 shows results of clustering analysis and tendencies generalization in IDPF LLC "Turbomach", particularly represents dependency of tendencies, united into clusters, on factors to quiclen their speed. On the basis of given tendencies clusters, which form IDPF LLC "Turbomach", next stage of prognostication is to develop their economic and mathematic models.

Table 2. Interpretation of clustering analysis data. Formation of IDPF

Cluster	Marking of tendencies, included into cluster	Generalized title of IDPF	Factors, which impact greatly the IDPF speed extension	Models
1	T_1, T_3, T_4, T_5, T_6, T_7, T_8, T_{11}, T_{37}	Production of the new products and their components	X_{11}, X_{12}, X_{22}, X_{51}	$S_1 = 0,077+0,234 \cdot X_{11}+0,125 \cdot X_{12}-0,152 \cdot X_{22}-0,241 \cdot X_{51}$
2	T_2, T_{15}, T_{27}, T_{30}, T_{32}, T_{39}, T_{44}, T_{46}	Technical changes with purpose of ecologization	X_{12}, X_{13}, X_{21}, X_{32}, X_{42}	$S_2 =0,938-0,145 \cdot X_{12}-0,398 \cdot X_{13}+0,073 \cdot X_{21}-0,376 \cdot X_{32}-0,149 \cdot X_{42}$
3	T_9, T_{10}, T_{12}, T_{16}, T_{17}, T_{18}, T_{26}, T_{43}	Technical changes in ergonomic features	X_{21}, X_{31}, X_{32}, X_{51}, X_{52}	$S_3 =0,661-0,354 \cdot X_{21}+0,014 \cdot X_{31}-0,159 \cdot X_{32}-0,186 \cdot X_{51}+0,039 \cdot X_{52}$;
4	T_{13}, T_{22}, T_{23}, T_{35}, T_{36}, T_{38}, T_{40}, T_{47}, T_{49}	Technical re-equipment of the internal mechanisms in production	X_{11}, X_{12}, X_{23}, X_{41}	$S_4 =0,178+0,104 \cdot X_{11}-0,27 \cdot X_{12}+0,198 \cdot X_{23}-0,155 \cdot X_{41}$
5	T_{14}, T_{28}, T_{31}, T_{33}, T_{34}, T_{45}, T_{48}, T_{50}	Using of the new materials	X_{21}, X_{22}, X_{51}, X_{52}	$S_5 =0,243+0,055 \cdot X_{21}+0,039 \cdot X_{22}-0,159 \cdot X_{51}-0,11 \cdot X_{52}$
6	T_{19}, T_{20}, T_{21}, T_{24}, T_{25}, T_{29}, T_{41}, T_{42}	Improvement of production technologies and quality standards increase (owing to unification)	X_{12}, X_{21}, X_{32}, X_{41}	$S_6 =0,214-0,066 \cdot X_{12}-0,061 \cdot X_{21}-0,011 \cdot X_{32}+0,065 \cdot X_{41}$

Note: T_1 _ T_{50} – perspective tendencies of LLC "Turbomach", selected on the basis of trend watching; X_{11}, X_{12}, X_{13}, X_{21}, …, X_{52} – relative estimations values of factors constituents, assisting extension speed

Source: own elaboration

Modelling was carried out in MS Excel (way: Data/Analysis of data/Reggression), where dependencies of the tendencies extension speed on factors constituents were revealed, included to IDPF, and made the biggest influence for every IDPF. According to the received coefficients the following models are formed.

According to main steps of models checking for significancy, adequaeteness and calculation of models accuracy, they were analyzed by the following factors: determination coefficient (R^2), conventional dispersion of the depending variable (σ^2), practical value of Fisher's statistics (F_{pr}) and significancy of models coefficients by St'udent's t-criterion.

Conclusions

Thus, as a result of the conducted research, one forms six clusters of the perspective tendencies for LLC "Turbomach" and creates IDPF of analyzed industrial enterprise: producing of new goods and their components, technical changes with purpose of ecologization, technical changes in ergonomic features, technical re-equipment of the production internal mechanisms, using of the new materials, improvement of production technologies and increase

of quality standards (including by means of unification). In order to prognosticate the the given IDPF extension speeds, multi-factor regression models are created in MS Excel. After checking the received models and their coefficients for accuracy, significancy, adequateness and correspondence to the real objects, there is opportunity to prognosticate innovative projects.

Abstract

Rapid development of new technologies, great science impact on the enterprises activity, orientation to the social and economic development, competition increase, speeding up cycle in introduction of the new goods and service to market are all factors, which influence the enterprise activity. Therefore average- and long-term prognostication is formula to create strategy and tactics for actions, which will have no disadvantages while introducing them.

The study of prognostication methods enables to select and unite methods for prognostication of innovative development perspective directions (PIDPD) at the industrial enterprises, which allow to combine the qualitative analysis of information concerning perspective development directions and their quantitative estimation with the purpose of future development models elaboration. The authoring methodical apparatus of PIDPD involves a complex process of prognostications, consisting of logically built stages.

Thus, the aim of the study is to develop methodic grounds for PIDPD stages implementation and their practical approbation with the purpose to trace the efficiency of their application at industrial enterprises' activity.

The research tasks and methods are:

— selection and analysis of an industrial enterprise for practical approbation;
— qualitative prognostication of innovative development directions for the chosen enterprise according to author's methodical apparatus of trend watching analysis;
— compiling the quantitative prognostication of innovative development directions for the chosen enterprise through a combination of cluster analysis and economic and mathematical modeling methods.

Due to research questions the content of the paper consists of the following sections: analysis of LLC "Turbomach", trend watching of LLC "Turbomach", clustering of perspective tendencies of LLC "Turbomach" and formation its IDPF, modelling of IDPF of LLC "Turbomach".

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