

Application of Alternative Approaches for Innovative Technology Obsolescence in Bulgarian Engineering Companies

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Abstract—The purpose of the present work is to present a study of the developed methods of alternative solutions in the assessment of innovation obsolescence in 15 engineering companies in Bulgaria, using the questionnaire method. First, the technology and organization of innovation obsolescence is assessed for each investigated enterprise separately. Second assessment of resources for innovation development. Third manifestation of innovation obsolescence by phases and fourth - Manifestation of obsolescence in individual innovation stages for each investigated enterprise separately, based on planned obsolescence.

Keywords—*alternative solutions, innovative obsolescence, questionnaire.*

I. INTRODUCTION

During the transition from the twentieth to the twenty-first century, there is an unprecedented accumulation of new knowledge in world history [1, 2, 3, 4]. This time coincides with the development of information and telecommunication technologies (ITT), with the creation of hitherto unknown opportunities for the use of arrays of new knowledge. The innovation activity is developed in all priority directions, incl. management, engineering, telecommunications. Scientific knowledge has been applied in new technological developments and is a powerful generator of economic growth at the macro and microeconomic level [5, 6]. The purpose of this article is to present a survey conducted among 15 enterprises in the mechanical engineering sector in the Republic of Bulgaria. For this purpose, a Questionnaire was developed, which was field-tested and shows the innovation obsolescence with the help of the alternatives for its assessment.

As part of what is new in science, the current dissertation "Alternative solutions against the rapid innovative obsolescence of technologies in mechanical engineering" is a current development. The dissertation deals with the main problems, tools and approaches for innovation management. An analytical study of the impact of innovative aging on technology has been made [7]. A methodology for selection of alternative solutions against rapid innovative aging has been developed, applying an

integrated approach to modelling aging itself - innovative and programmatic, and proposed for application known - a method for determining the degree of innovation; method for innovation activity; method for innovative aging and method for alternative solutions. The developed algorithm for connection and symbiosis between the methods achieved the desired result. The prerequisites for the application of the methodological statement for selection of alternative solutions are defined. Approbation of the methodological position in 15 Bulgarian enterprises in real production conditions was made. It has been unequivocally proven that innovative aging is a regularity and that it takes precedence over physical wear and tear. An alternative approach to choosing solutions to reduce the harmful effects of rapid innovative aging is proposed. All this proves the relevance of the development and the possibilities for application in SMEs in the Republic of Bulgaria [8, 9].

For this purpose, an object (enterprise) was chosen for the experiment. As an approbation of the methodological setting in real production conditions, a selection of 15 small, medium and large machine-building enterprises in the Republic of Bulgaria was made [10, 11].

The testing methodology (experiment) includes:

1. Technology and organization of innovation development and innovation obsolescence for each group of investigated enterprises (small, medium, large);
2. Resources for innovation development for each investigated enterprise separately;
3. Manifestation of innovation obsolescence by phases for each investigated enterprise separately;
4. Manifestation of obsolescence in the individual innovation stages for each investigated enterprise separately.

The obtained data are summarized and presented in tabular form.

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II. MATERIALS AND METHODS

Technology and organization of innovation development and innovation obsolescence for each group of investigated enterprises (small, medium, large) - Table 1.

TABLE 1 INNOVATION DEVELOPMENT TECHNOLOGY AND ORGANIZATION, INNOVATION OBSOLESCENCE

Does the enterprise have a programmed development of innovation activity and innovation obsolescence, including	YES	NO
Programmed innovative development and innovative obsolescence of technologies and production products	+	
Development of new (innovative) products	+	
Other innovative solutions	+	
Does the enterprise have a strategy for development activities, including:	YES	NO
Own design and construction office.	+	
Comprehensive product design development.	+	
Product design.	+	
Control over the product manufacturing stages.	+	
Shortened time from idea to product reaching the consumer.	+	
Is there a strategy for personnel development, including:	YES	NO
Maintaining the qualification level of the staff.	+	
Involvement of all personnel in the formation the construction and implementation of the company's innovation strategy.	+	
Leveraging staff knowledge to radically improve innovation processes.	+	
Using the advantages of multifaceted knowledge of problems to expand the innovative capabilities of the company.	+	
Is there a marketing strategy.	+	
A market strategy to target	YES	NO
Improving operational and innovation efficiency.	+	
Promotes customer loyalty to innovative products.	+	
Rapid response to customer needs for innovative solutions.	+	
Encourages effective use of market opportunities to offer innovative products.	+	
Competitively acceptable prices of the innovative products intended for the market.	+	
Reduction of innovation risk.		+
Quality incl.	YES	NO
ISO certification level.	+	

Resources for innovation development for each investigated enterprise separately – Table 2.

TABLE 2 RESOURCES FOR INNOVATION DEVELOPMENT FOR EACH INVESTIGATED ENTERPRISE

What resources for innovation development does the company have, including	YES	NO
Material, including available equipment and technologies	+	
Temporary (carrying out modernization, delivery of new high-performance equipment, new technologies, etc.)	+	
Cash (on hand, bank, loan, programs, etc.)	+	
Information resources available, attraction, etc.	+	
Using the Internet and searching and analyzing information	+	
Do you use the following internet practices?	YES	NO
Virtual distribution of information related to technology and work organization;	+	
Internet coordination of various activities, technologies, constructions, transports, as well as joint implementation of assembly work;		+
Directories for storing technological and constructive novelties (innovations);	+	
Online procurement with innovation suppliers and consumers.	+	
Technologies in virtual and real time;		+
Customer service and innovation websites.	+	
Search and analyze information	YES	NO
Research on a regular basis the opinion of users about innovative products and the individualization of the technological product.	+	
Monitoring the actions and tactics of competitors regarding innovative designs.	+	
Forecasting sales of innovative products and anticipating changes in consumer preferences;	+	
Using market research and research on novelties;	+	
Regular monitoring of publications related to innovations in the company's sector of activity;	+	
Conducting strategic innovation intelligence;	+	
Search for additional sources of information.	+	
Human Resources	+	
Human resource management is targeted on hiring creative people, including:	YES	NO
Highly qualified staff with experience and seniority;	+	
Multifaceted competence.		+
Development opportunities for associates at all levels, including:	YES	NO
Create effective communications;	+	
Monitoring the satisfaction of all associates.		+
Creative management, including	YES	NO
Encouraging people who introduce innovations and changes;	+	
Participation in training programs;	+	
Stimulation of innovative proposals;	+	
Guaranteeing interesting work;	+	
Development of staff skills.	+	

Manifestation of innovation obsolescence by phases for each investigated enterprise separately on Table 3.

TABLE 3 MANIFESTATION OF INNOVATION OBSOLESCENCE

In production phase.	YES	NO
Programmed obsolescence;	+	
No programmed obsolescence.	+	
In the post-production phase (Operation).	YES	NO
Programmed obsolescence;	+	
No programmed obsolescence.	+	
Solutions for programmed aging.	YES	NO
Are alternative solutions taken?		+

Questionnaire. To study the manifestation of innovation obsolescence and alternative solutions to eliminate its harmful consequences.

(Answer YES or NO)

1. Mechanical engineering company for: "MONEK - SOUTH" JSC, Kardzhali, production of mining and beneficiation and metallurgical equipment, mining and drilling tools, spare parts, rubber products, repair and related engineering activities.

2. Own construction unit. YES

3. Do they use alternative solutions. YES

4. Do they apply programmed obsolescence. NO

3. If it was used, in which of the innovation phases was it used; idea, design, production, service. IDEA, DESIGN, PRODUCTION. NO

4. What are the results; good, average, no positive results and benefits. GOOD

5. Other opinions and suggestions.

Conducted the survey: Date.....

Each of the 15 companies was surveyed and based on the data received, the following tables were systematized: Table 1, Table 2, Table 3, Table 4, Table 5, Table 6 and Table 7. The data in this case are for "MONEK - SOUTH" JSC, town of Kardzhali [11 - 16].

III. RESULTS AND DISCUSSION

Manifestation of obsolescence in the individual innovation stages for each investigated enterprise separately.

Note: Planned obsolescence is taken as a base.

Conceptual stage - on Table 4, but design stage - on Table 5.

TABLE 4 CONCEPTUAL STAGE

№	Activities	Time Hours %	Deviations – time increase/ decrease in hours %
1	Generating ideas	100	-5
2	Methods of generating ideas	100	-5
3	Methods for evaluation and selection of ideas	100	0
4	Criteria for evaluating ideas	100	+3
5	A selection of ideas	100	0
6	Technical assignment	100	0

TABLE 5 DESIGN STAGE

№	Activities	Time Hours %	Deviations – time increase/ decrease in hours %
1	Idea solutions - marketing	100	-8
2	Work solutions - marketing	100	+4
3	Choosing a design approach	100	0
4	Choice of 2D or 3D methods	100	+10
5	Combining the stages - KI	100	-10
6	Simulation, models, virtual reality	100	-2

Production stage is present on Table 6.

TABLE 6 PRODUCTION STAGE

№	Activities	Time Hours %	Deviations – time increase/ decrease in hours %
1	Technical training	100	-20
2	Production (phases: preparatory, processing, assembly)	100	+1
3	Testing, control, storage	100	10

After production stage (service) - present on Table 7.

TABLE 7 AFTER PRODUCTION STAGE

№	Activities	Time Hours %	Deviations – time increase/ decrease in hours %
1	Service - monitoring, registration	100	-20
2	Feedback	100	-20

The survey card developed for the purpose is as follows:

A summary of the study is in Table 8 [17, 18].

TABLE 8 A SUMMARY OF THE STUDY

Company name	N_n	S_m	M_m	L	AR	
1	2	3	4	5	6	7
1	"MONEK-YUG" JSC, Mining equipment	100	1	0,20	20	Outsourcing
2	"DINAMO SLIVEN" JSC El. engines etc.	100	1	0,15	15	Outsourcing, applications
3	"LIEBHERHAUSGERETE MARITSA FOOD Refrigerators, freezers	70/100	2	0,50	50	Modules, programmed obsolescence
4	"VITTE AUTOMOTIVE BULGARIA" LTD Locking systems	50/80/100	3	0,80	80	Programmed obsolescence, software applications
5	"TRANSVAGON" JSC Freight cars	100	1	0,20	20	Outsourcing
6	SKYMONT" OOD Equipment for the mining, chemical industry	100	1	0,30	30	Outsourcing, modules, applications
7	"ZMM-SLIVEN" JSC Mechanical engineering, equipment	100	1	0,20	20	Outsourcing
8	"TEREM-IVAYLO" EOOD Military equipment	100	1	0,40	40	Modules, applications
9	"HEM" JSC Apparatus for energy, etc.	100	1	0,30	30	Modules
10	"MADARA AGRO" LTD Agricultural machinery	100	1	0,30	30	Modules
11	"HYDROPLASTFORM" LTD Canning industry equipment	100	1	0,2	20	Outsourcing
12	"FABKO" LTD Lathes, mills	100	1	0,10	10	Outsourcing
13	"ALPEN AND SONS" LTD Tool equipment	100	1	0,20	20	Outsourcing
14	"DARM" Ltd	100	1	0,40	40	Modules

	Punches, pointed forms, etc.					applications
15	"DIANGELI" ET Measuring tools	100	1	0,30	30	Applications

Note: N_n - Degree of innovation (J_{ino}), % Basic product; S_m - Innovation activity (S) Number Basic product; M_m/L - Innovative aging (M), % Basic product; AR - Alternative solutions (AR) 1. Programmed obsolescence 2. Modular constructions 3. Outsourcing

IV. CONCLUSIONS

A methodology was developed and tested in 15 engineering enterprises.

A questionnaire was developed.

An analytical study of the state of innovation development and innovation obsolescence in the selected engineering companies was carried out. On this basis, it has been established that innovation obsolescence has priority over physical obsolescence.

The applied alternative approach for choosing solutions to reduce the harmful impact of rapid innovation obsolescence has been tested in these enterprises. The obtained results prove its practical and theoretical significance and applicability.

Analytical results show that between innovative and "programmed" obsolescence we have both a mutual relationship and a different functional significance. One is a regularity, and the other can be an alternative to rapid innovation obsolescence.

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