

SOME IMPACTS ON THE MANAGEMENT OF THE NEW PRODUCT DEVELOPMENT PROCESS BY MACHINE MANUFACTURERS IN BULGARIA

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Abstract. The success of the new product and its development program is directly related to the effective management, planning, organization and control of influencing factors. The identification of these factors is a critical point in the management of the organization. The presented study examines the new product development process of machine manufacturers in Bulgaria. The aim of the authors is to identify factors that ensure market success of manufacturing enterprises through the study of methods, tools and practices for improving the management of the researched process. The results present data on the management process and the organization of the innovation process and reveal a small part of conducted research aimed at identifying influencing factors on the success of new products.

Keywords: management; innovation process; new products development; manufacturing industry

JEL: L6, MI, O3

1. Introduction

The term innovation is primarily associated with research and development aimed at creating new or improving existing products. The basis of innovations is the process of knowledge, but knowledge itself is not equivalent to innovation – it precedes it and only if a specific practical application is found, it turns into a new product or service. Innovation is the process of discovering, learning and applying new technologies and techniques from many sources. It is a driving force of progress and a key factor in achieving a competitive advantage for industrial enterprises. The goal is to overcome the barriers preventing innovation. (Kozludzhova, 2023) The generation of innovations is a process that is a set of separate interrelated phases. It consciously aims to optimize the management and organization of the innovation process with a view to creating products that have market success. Questions related to the new product development (NPD) process and its effective management have long intrigued the attention of scientists (Falahat et al., 2024). Efforts are aimed at identifying best management practices and differentiating crit-

ical factors for the success of industrial products (Kunev et al., 2018).

Attention should also be paid to the ubiquitous penetration of artificial intelligence in the business sector (Molhova & Biolcheva, 2023; Biolcheva & Sterev, 2024). The application of intelligence and imagination leads to the creation of business models, inferring correlations and regressions between factors that can to escape into the engineering process and analyzing the collected data (Browder et al., 2022; Vitliemov & Stoycheva, 2022).

The **subject** of analysis in the present study is the management of the product innovation process.

The **object** of analysis are medium and large organizations according to the criterion number of personnel, operating in sector 28 “Manufacture of machines of general and special purpose”.

The **purpose** of the study is to identify successful management practices and influencing factors leading to the success of NPD programs.

In order to achieve the set goal, the following tasks were completed: (1) the essence of the innovation process was presented in a synthesized way; (2) research methodology is formulated; (3) the obtained results are analyzed; (4) factors affecting the success of NPD in the machinery and equipment manufacturing industry are presented.

The **research methods** used include a combination of qualitative research methods – office study of the researched problem and drawing up a survey questionnaire and quantitative research methods – use of descriptive and general statistics.

2. Research of the process of developing new products

How the new product development process can best be organized is a perennially relevant question that engages the attention of researchers (Riel et al., 2013; Barczak et al., 2009). Creation of new products increases competitive advantages and is the basis for market consolidation of industrial enterprises (Floren et al., 2017; Dorokhova et al., 2024). In the present study - the exploration of the process of developing new products in industrial organizations is aimed at obtaining general information about the enterprises, researching the NPD program, the management of the innovation process, its organization and used methods and tools, as well as barriers to development. The aim is to identify factors influencing the success of innovative product programs, as well as managerial decision-making and management practices associated with high success rates.

2.1. Research methodology

Data on machine manufacturing organizations with over 50 employees provided by the National Statistics Institute.¹ These are organizations operating in sector 28 “Production of machines of general and special purpose”. To study the process of developing new products in Bulgarian industrial enterprises a survey card was

¹ National Statistical Institute of Bulgaria – <https://nsi.bg/bg> (Last access 20.08.2024).

developed. Initially, a pilot study was conducted in five organizations operating in the researched sector to establish the clear wording of the questions. As a result of the received feedback, some of the statements included in the questionnaire are reformulated and others are reduced. This is how the final version of the checklist is formed, including questions giving a general idea of the organization and the activities carried out in it, information about the process of developing new products, their management, the organization and the applied methods and tools.

The survey form is aimed at a specialist in the enterprise responsible for developing new products or a person with a broad knowledge of the activities of the relevant organization such as an executive director or manager. The research is intended for medium and large organizations in the territory of the country according to the number of employees in them. This is also one of the limiting conditions of the conducted research. When the data were collected, they were stored using specialized software for statistical data processing SPSS. The methods of analysis used include *Descriptive statistics*, as *average values are calculated*, according to which, the obtained results can be analyzed and would be a basis for carrying out a comparative analysis when conducting future studies. Some of the data is organized using *a frequency distribution*. From the general statistics, *a correlation and regression analysis* were made to establish statistical interdependencies between the studied factors and the evaluation of the influence of the determined dependencies.² This article mainly presents results from basic statistics. The analysed correlation and regression relationships leading to the derivation of influencing factors are not presented in detail in this publication.

2.2. Research results and analysis of data obtained and influencing factors

According to the data of the National Statistical Institute, the machine manufacturing organizations in Bulgaria with more than fifty personnel is 86. The research sector includes *machinery manufacturers with a total purpose* (Manufacture of turbines and engines, excluding aviation, automobile and motorcycle; Manufacture of hydraulic pumps, hydraulic and pneumatic engines; Manufacture of other pumps and compressors; Manufacture of fittings; Manufacture of bearings, gears and couplings; Manufacture of furnaces and burners; Manufacture of lifting and transport machinery; Manufacture of office equipment, non-computerized; Manufacture of portable tools with built-in motor; Manufacture of industrial refrigeration and ventilation equipment; Manufacture of machinery for agriculture and forestry; Manufacture of machinery for agriculture and forestry) and *manufacture of other special purpose machinery* (Manufacturing of machinery and equipment for metallurgy and foundry; Manufacture of machinery for mining and construction; Manufacture of machinery and equipment for food, beverage and tobacco processing; Manufac-

² The first publication of the research on management aspects and policies in the development of new products in medium and large industrial enterprises was made in 2018 (Stoycheva & Antonova, 2018).

ture of machinery for textiles, clothing, leather and leather goods; Manufacture of machinery for paper, cardboard and paper and cardboard products; Manufacture of machinery for rubber or plastics). In the survey, 50 organizations, including the sector of manufacturers of general and special purpose machines, take part, as the data obtained can be taken as representative. They can also be used by other economic sectors, but without any pretence of direct transfer.

The enterprises in the studied population consider their NPD program to be successful, the main argument for this being that they have the necessary modern equipment. In 84% of the surveyed organizations, purely financial goals are set, and for more than 65% of the respondents, the measurement of the obtained results is up to a few months after the new product is released on the market. Financial indicators are rarely (only 6%) measured in weeks, as well as in years (28% of respondents).

The average number of employees in the surveyed organizations is 252, with 61% of the respondents generating turnover mainly from exports. There is a strong dependence on the main three largest customers. The most important factors for them are the high quality of the product; reliability and short delivery time; as well as long-term business relationships. The price and design of the product, the wide product range and the after-sales service are important. Factors such as geographical proximity, language and culture are irrelevant to customers.

Only 5% of respondents produce world-first products, with organizations mainly focusing their efforts on imitative and adaptive innovations (Table 1).

Table 1. Categories of new products in organizations (%)

New product categories	Total performance for the last 5 years
World news products	5
New product lines for organization	12
Additions to existing product lines	16
Mainly modified on manufactured products	18
Gradually improved products produced by the enterprise	25
Repositioning of products	13
Reduced cost products	11

A critical element of the overall corporate strategy is precisely the new product development program (Mihaylova & Papazov, 2024). A specialized NPD innovation product strategy is owned by 74% of respondents, and the implementation of a well-defined, structured process for managing the entire portfolio of NPD projects is characteristic of 76% of respondents.

The study of the *innovation strategy of the organizations* (Table 2) shows that half of the organizations (51.4%) direct their efforts to discover and maintain a secure niche, where thanks to the competitive advantages they offer, they protect their place in the market. The obtained results are reasonable and correspond to the answers to previous questions. It is surprising that a significant part of the respondents – 37.1% want to be market leaders with the products and technologies they offer. 8.1% of respondents say that when introducing their new products, they follow the market leader, which sometimes brings them greater profitability than expected. Only 2.7% claim that they are not aggressive towards competitors and react to changes only when they are inevitable. The responses are summarized in Table 2.

Table 2. Description of the innovation strategy (%)

Place in the market	First	Rarely first	Secure niche	Not aggressive
Researched Organizations	37,8	8,1	51,4	2,7

Organizations apply different structures in the management of NPD projects. The results (Table 3) indicate that top management does not delegate responsibility to managers and staff. For 18.8% of respondents, the responsibility for developing the strategy for new products rests entirely in the hands of top management. With 27% of respondents, ¼ of those involved in new product strategy development are line managers and staff. At 51.4%, responsibility between senior management, managers and staff is evenly shared. At only 5.4%, new product strategy development is basically 75% in the hands of managers and staff. The proportion (2.7%) in which senior managers delegate the development of new product strategy to line managers and staff is insignificant.

Table 3. New product strategy development balance between senior management, line managers and staff (%)

NPD Management	Senior Management	75	50	25	Functional managers
Researched Organizations (%)	13,5	27	51,4	5,4	2,7

A small proportion of respondents (12%) do not use a documented process for NPD. The highest percentage (46%) implements parallel teams. 30% use one team, and for 12% of respondents, each set of tasks is performed by a separate work group (Table 4).

Table 4. Descriptive statistics of the new product development process (%)

New product development process	Researched Organizations (%)
We do not use any formally documented procedure when developing new products.	8
We currently do not use any formally documented process for new product development, but we do apply a series of activities that we have informally adopted as the way new product development is conducted in the enterprise.	4
We have formally documented processes where on one feature a team completes a set of tasks, the results are reviewed, and then the same team moves on to the next feature where another set of tasks is tackled.	30
We have formally documented processes where one team executes a set of tasks, reviews results and gives the go-ahead to another responsible for the next set of functional tasks.	12
There are formally documented processes where parallel teams use overlapping processes, ongoing phases with interaction, and management makes decisions after dialogue with a mixed group of teams.	46

An important question describing the innovation process is related to its *renewal* (Table 5). Almost half of the surveyed organizations (41.30%) apply formally documented procedures, carrying out timely process renewal, leading to its overall improvement.

Table 5. Frequency of updating the new product development process (%)

Process update	Ongoing	Once every 6 months	Once a year	Every 2 years	Every 5 years	We do not update the process
Researched Organizations (%)	41,30	6,52	30,43	8,70	8,70	4,35

New product ideas can come from a variety of external or internal sources. Mainly in Bulgarian industrial enterprises, they come from users or customers, which is another proof that organizations implement ready-made customer solutions to be sure of the success of the innovation. Influence and impetus for development is provided by senior management, competitors, new equipment and technology acquired, colleagues in the organization, as well as the Internet. Less often, innovation ideas are initiated by suppliers, consultants, and universities or research institutes. The results unfortunately show that the connection between science and real business practice is rather weak or absent.

At the business unit level, 93% of respondents have an executive director who is responsible for the final strategic and operational aspects of the product. In managing the innovation portfolio, the following techniques are applied: rate and time of investment return; net present value; checklists and assessment models; project ranking.

When structuring NPD efforts (Table 6), the largest number of respondents (50%) indicated that the executive director of each business unit leads NPD efforts. 84% of manufacturing enterprises rely on an R&D department that is permanently staffed. Next in the hierarchy of needs is the “New Product Committee”, which oversees all activities related to their development. This is most often seen in wood product manufacturers. The use of outsourcing of individual activities in NPD is not widely advocated, being applied by only 14% of respondents. The main reason for the minimization of outsourcing innovative product activities, according to the respondents, is a strategic decision of the top management, which believes that in the long term it is more profitable to form own NPD functions. 8% of surveyed engineering companies use a manager of each product development project who is also tasked with distributing it throughout the enterprise.

Table 6. Description of new product development efforts in your organization (%)

New product development efforts	Researched Organizations (%)
New product development department with permanent staff	84
Parts of the NPD projects are carried out by external partners (outsourcing)	14
A „New Product Committee“ oversees all activities related to their development	28
The CEO for each business unit leads the NPD efforts	50
The manager of any product development project can distribute it throughout the enterprise	8

For the functional unit responsible for NPD, data indicate that for 38% of participants NPD is a shared responsibility; for 36% - the functional responsible unit is the engineering one and only in 24% - it is in the hands of the research and development group. Even lower is the percentage where this task is entrusted to the strategic planning team (2%).

The results obtained for general and special purpose machinery manufacturers regarding the methods used to reward the manager and team members reflect a narrow set of decisions. Reward methods used are praise at organized company dinners, festive lunches and the opportunity to work on a bigger project next time. Temporary pay is also typical for project managers (Table 7).

Table 7. Application of reward methods (%)

Compensation methods used in your enterprise	Project Manager			Project Members		
	never	often	always	never	often	always
Distribution of project profit	88	10	2	90	8	2
Shares or share options of the project	100	-	-	100	-	-
Temporary pay	30	50	20	56	28	16
Praise in the organizational newsletter	80	16	4	84	12	4
Compliment of an organized company dinner	62	36	2	70	28	2
Posters, pins, project photos	80	16	4	84	12	4
Festive lunches, dinners	42	56	2	48	52	-
A non-financial award chosen by the team	88	12	-	88	12	-
Opportunity to work on a bigger project next time	4	50	46	4	72	24
Other financial award (specify).....	-	-	-	-	-	-
Other non-financial award (specify)	-	-	-	-	-	-

For manufacturers of general and special purpose machinery, the specified NPD process management practices are of limited application. The team's independence is more often relied on (Table 8).

Table 8. Application of different practices (%)

Frequency (%) of use	Never	In 25% of cases	In 50% of cases	In 75% of cases	Always
Types of practices					
A professional project manager whose sole job is to manage projects.	52	10	10	12	16
Project manager appointed full-time until its completion.	70	6	12	2	10
Part-time project manager who also has other duties.	80	6	6	4	4
The project team is self-oriented.	34	22	26	8	10

The conceptual creator of the project plays the role of manager.	64	14	6	10	6
The project manager can hold any position in the organization.	70	10	4	8	8
Other (specify):	-	-	-	-	-

Respondents are asked to indicate how often they use various practices related to NPD teams. The use of interconnected teams, helping each other and working in parallel, is a success factor in RNP (Sterev et al., 2020). For the manufacturers of general and special purpose machines, the data show that in 50% of cases clear goals and objectives are established for the team, and in 54% they are related to the company strategy. For 50% of cases, rapid team formation is not characteristic. For 70% of respondents, training of mixed teams from different functional areas is not implemented. Group members apply their expertise to the project; accept assistance from other functional departments and cross-functional teams; exchange knowledge that finds different applications in new projects (see Table 9).

Table 9. Application of different practices in new product development teams (%)

Frequency (%) of use	Never	In 25% of cases	In 50% of cases	In 75% of cases	Always
Types of practices					
Training of mixed teams from different functional areas	70	18	4	8	-
Team members apply their expertise to the project	2	-	32	34	32
Team members accept the help of other functional departments to deal with the problem effectively	14	22	28	26	10
Mixed teams share knowledge	18	20	20	22	20
Clear goals and tasks are established for the team	6	2	6	36	50
Team goals and objectives are related to company strategy	6	-	8	32	54
Quick team formation	50	20	2	10	18

An interesting object of study are those persons who guide the NPD process and the practices they use (Gang & Vitliemov, 2024). Project manager training is

common. In this regard, researchers emphasize talent discovery and the need for entrepreneurial training (Sterev, 2023; Pavlov, 2022). Support from line managers and top managers is more moderate. It is characteristic of 52% of technological ones; 46% of production and 40% of marketing managers. In 44% of cases, top managers support the innovation by providing structures, processes and other organizational mechanisms supporting the innovation. In 40% of cases, the problem-free access of resources to the innovation project is always monitored. In 30% of cases, top managers always make long-term investments in technology and production (Table 10).

Table 10. Applied management practices (%)

Frequency (%) of use Types of practices	Never	In 25% of cases	In 50% of cases	In 75% of cases	Винаги
Project manager training	10	26	44	14	6
Technology managers support innovation by ensuring active and effective participation of their staff in the team	4	2	16	26	52
Production managers support innovation by ensuring active and effective participation of their staff in the team	2	8	16	28	46
Marketing managers support innovation by ensuring active and effective participation of their staff in the team	4	10	18	28	40
Top managers support innovation by providing structures, processes and other organizational mechanisms	4	8	26	18	44
Top managers support the innovation by making sure that the necessary resources reach the innovation project without any problems.	2	12	30	16	40
CEOs make long-term investments in technology, manufacturing, etc. to support ongoing innovation	6	14	36	14	30

3. Conclusion

Based on the research, the following generalizations and guidelines can be drawn:

1. Organizations producing general and special purpose machines are more conservative in their product portfolio. They develop adaptive and imitative products.

The percentage of radical innovations generated is negligible (only 5%). *A push for development can be the attraction of resources from European programs for the implementation of innovation projects and strengthening of cooperation with organizations in and outside the country.*

2. For the surveyed organizations, the existence of a documented process for NPD is the rule. *They are aware of the importance and benefit of process formalization of NPD, as its application minimizes the risk of missing procedures and is a basis for growing experience.*

3. It was found that the ideas generated were mainly from users or customers, senior management, or from tracking competitive actions. The connection between science and real business practice is rather weak or absent. *Ways to improve business-university links should be sought. This can be done by providing internship programs and commissioning doctoral studies. It is necessary to strengthen the funding of fundamental and scientific applied research on the part of business on a practical problem that has arisen.*

When developing new products, general managers should delegate more authority and tasks to line managers, thus employees will feel meaningful and engaged in the work, which will have a direct impact on the efficiency of the work process.

4. The research shows that the trend is mainly for chief managers to be responsible for NPD. *They must create an environment that supports innovation and remove any resistance to innovation and change. This can be done by organizing trainings for both project managers and team members. The frequency of application of various methods and techniques for managing the innovation portfolio should be strengthened, including the use of checklists, evaluation models, ranking of projects and selection of alternatives.*

5. The use of outsourcing is limited (14%). *It should be accepted that outsourcing can be a new competitive weapon and efforts should be made to search for strategic partners.*

6. It is not typical for the studied organizations to apply a complex of remuneration methods, both for the project manager and for the team members. *This is an area that badly needs better management and attention from top managers. We should not forget the fact that human resources lead the organization and contribute to its prosperity. Incentives are a powerful argumentative weapon, and the motivation of the human factor is the key to its effective management. In this regard, a clear and fair system for financial motivation in the enterprise must be built in order for the employees to feel correctly evaluated and receive the incentives they deserve.*

An emphasis that needs to be improved is the used tactics of forming the project teams. The priority is the creation of mixed teams from different functional areas, encouraging communication between functional departments; the exchange of knowledge and experience; and providing team mutual aid.

Factors with a direct influence on the NPD process are support for innovation, both by top managers and technological, production and marketing managers. Emphasis on this aspect can also be strengthened with a view to promoting mutual assistance and communication between teams from different functional areas and showing attention to innovation on the part of top managers.

7. The ever-growing and changing needs of consumers/customers in most organizations necessitate the use of various marketing methods and techniques. *This reflects on reducing the risk of changing target attitudes and perceptions towards the manufactured product. With particular force, the approach is a must for users interested in developing radical innovations.*

8. In modern enterprises, information systems are a powerful organizational and management tool, which is why the need to design and implement information systems has never been more relevant. Organizations are beginning to implement a wide variety of software tools to support project design and management.

Acknowledgement

This study is financed by the European Union-NextGenerationEU, through the National Recovery and Resilience Plan of the Republic of Bulgaria, project № BG-RRP-2.013-0001-C01.

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