

EVALUATION OF REASONS FOR DECISION TO IMPLEMENT NEW TECHNOLOGIES IN LITHUANIAN MANUFACTURING ENTERPRISES

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Abstract

This paper presents the findings of survey, which aimed to investigate the most important reasons involved in the implementation of new technology within the Lithuanian manufacturing enterprises. The research carried out indicated the fact that in the recent years, the connection of industrial progress, organizational changes and economic competitiveness has increased. One of many significant changes in technological and economic environment of industrial enterprises is related with the increasing dissemination of technological innovations and commercial profit, obtained having implemented new technologies in industry. The competitiveness of enterprises and the state is directly dependent on their ability to acquire and implement new business methods and new technologies, as well as use them in the production of new competitive products. The causal analysis of new technology implementation in manufacturing enterprises provided possibilities to group reasons and that were significant for implementing new technologies in enterprises, with regard to internal aims and external aims of enterprises.

Keywords: new technology, technology implementation decisions, reasons of technology implementation.

JEL Classification: O12, O14, O32.

Introduction

The direction and pace of scientific and technological progress was identified to be of big importance for the future state of manufacturing in Lithuania. The manufacturing sector has been facing a strongly cost-driven environment with global competition and intense pressure to reduce costs and improve production efficiency. Advanced knowledge management tools have facilitated the co-operative development of new products within virtual factories. Achievements in information technologies, electronics, chemistry and materials science indicate that the technological base of many industrial areas is rapidly changing and is difficult to be forecasted. The number of newly developed technologies that could be chosen by industries today has significantly increased. This is extremely important for manufacturing enterprises, whose successful development of the activity requires expeditious strategic decisions, constant analysis of business environment and predictions of new alternatives for the activity.

Within this currently complex and rapidly changing business environment, development tendencies of technologies and their implementation in the industry is more often emphasized in the scientific literature. Many scientists evaluate the technology as an integrated phenomenon that combines different, interrelated and interactive technical and social factors (Machuca et al, 2011; Fontes, 2008; Baccarini et al, 2004; Chambers, 2004; Cua et al, 2001). In scientific publications the implementation of new technologies is interpreted as a conversion of the potential of science and technical advance, embodied in new products. Due to this, the development of new technologies and their implementation in the industry has become one of the most significant factors of Lithuanian economic strategy, determining the speed and results of the economic-social development (Masalskis *et al* 2001; Jucevicius *et al* 2006; Bernatonyte & Normantiene, 2009; Saboniene 2010).

The causal analysis of new technology implementation in manufacturing enterprises provided possibilities to group reasons, that were significant for implementing new technologies in enterprises, with regard to internal aims (creation of a unique product or improvement of existing ones, pursuit of technological/competitive advantage, availability of specific information resources, possibility to attract financial resources, increase of technological capacity, reduce of production costs) and external aims (increasing customer needs, increasing competition in the market, strategic decision of competitors, positive political environment for investments, rapid development of technologies, shortening of technology lifecycle) of enterprises.

Object of the research – reasons for decisions to implement new technologies.

Goal of the research – to reveal analysis of the process of new technologies implementation in Lithuanian manufacturing enterprises by evaluation the main reasons determining decisions to implement new technology and the main problematic areas of this process.

Research methods – general research methods are used in a paper such as: the systemic comparative and structural analysis of scientific literature, graphical modelling. Empirical research is based on qualitative methodological approach. Processing the results there were used SPSS and Microsoft Excel software.

Theoretical background

Technology is assessed as one of the most important resources of an industrial enterprise in scientific literature, so one of the main strategic decisions of an enterprise is to foresee the enterprise's position with regard to technological particularity and the change of technologies in the industry. The questions of implementing new technologies are especially important for competitive enterprises that act in industries receptive to technologies and that use technologies as one of the main resources in the contemporary ever changing market. Seeking for successful competition enterprises must be flexible, dynamic, and able to react quickly to market changes. The size of an enterprise by itself does not safeguard the keeping of competitive advantage in a market. Knowledge and information are the real resources of enterprises able to create the necessary value for consumers.

Brunner & Cali (2006), Szirmai *et al.* (2005), Mereuta *et al.* (2010), Bone and Saxon (2000), Zahra *et al.* (1999), Branscomb & Auerswald (2002), Hill and Rothaermel (2003) emphasized the importance of technologies as a strategically important means for enterprises for performing business. They stressed the critical importance of the interaction between the general strategy and the technological strategy of an enterprise. In many works the importance of new technologies when seeking to create a competitive advantage, i.e. when using the possibilities of creating innovative products for creating the potential of new technologies, is emphasized. Many authors (Willcocks, 1992), (Doukidis *et al.*, 1993), (Palvia *et al.*, 1994), (Garcia & Calantone, 2001) agree that strategic decisions of an enterprise and their assessment are an essential area of economic research, helping enterprises to increase efficiency of their activities. It is most important for all industrial enterprises to efficiently assess possibilities, to acquire and use necessary resources, and to choose a suitable moment for investment, because these factors determine an enterprise's success. Leaders of enterprises should solve questions of technological investments in each enterprise that is connected with the technological sector where, when assessing the impact of investments on the enterprise's activities, future technological development and the enterprise's speed of implementing technologies must be prognosticated, and the future competition strategy of the enterprise as a market participant must be foreseen. In a quickly developing business environment these problems may be denominated as optimal management of technological investments, maximizing the enterprise's value over the prognostication period.

A wider and versatile analysis of factors of enterprises' innovative activities is reflected in contemporary conceptions of technological innovations. Development of technological innovative activities of enterprises is related to the state support for scientific research, cooperation between enterprises, scientific research institutions, and clients, information dispersion among economic subjects, etc. Murphy and Simon (2002) acknowledge that in the modern-day economic environment many investments performed by enterprises into new technologies are connected with information and the speed of its reception and reclamation, therefore expected results most often are of non-financial nature, but they help enterprises to create new value. Strassmann (1997) notes that motives of direct benefit that may be clearly identified from investments into new technologies are the decrease of expenditure or increase of income, but also the author distinguishes factors that are more difficult to assess: decreased business risk, avoidance of additional expenditure, and acquisition of competitive advantage. The author groups competitive advantage according to its nature into the following categories: strategic advantage, tactical advantage, and advantage of activity processes. Based on empirical research Freeman (1995) states that the industrial sector where an enterprise acts has a big importance for innovative processes in that enterprise, i.e. that innovations in an enterprise or a market are firstly determined not by market demands, but by implemented new technologies or existing specific knowledge.

Many scientists, who researched the peculiarities of activities of Eastern European enterprises, especially emphasized the legacy of the planned economy, the reluctance to change, difficulties adapting to the fast changing market requirements due to small inner flexibility of enterprises, risk avoidance, fear to take responsibility, and little employee pro-activeness (Juscus & Snieska, 2008; Vasauskaite *et al.*, 2011, Banyte & Salickaite, 2008). Seeking to survive in such a dynamic situation an enterprise needs to understand

what is going on in the inner as well as outer environment of the enterprise and to take corresponding actions. Research of enterprises' personnel, performed by Schein (1992), has shown that resistance to change is expressed in all organisations, and since all innovative activities are related to smaller or bigger technological or organisational changes, the main task of leaders of organisations is to create a climate, favourable for innovations, and to organize innovative activities in smaller structural departments. Irani (2001) states that the insight of leaders of enterprises in the area of technologies is very important, and it is difficult to express its assessment and provision of strategic advantages with the help of quantitative indices. Besides, research has determined that there is a big correlation between the general efficiency of innovative activities, qualification of scientists and engineers, management quality, and the view of leaders on innovations. Therefore the need to constantly develop the process of technical and professional teaching of employees and to systematize the presentation of scientific results, new methods, and management styles becomes especially important. Many enterprises invest a lot of resources into activities of scientific research and development. But often it happens that results of such activities are not passed over and applied in other areas of activities (Badawy, 1993). Enterprises need to observe early market signals if they want to react fast and receive essential information from the market and spread it to all participants of the supply chain (Mohr et al., 2001).

Enterprises, seeking to keep their competitive advantage, should constantly change management models with regard to the situation of competitiveness in the market. Manufacture competency should be related to market demands. As emphasized by Corbett and Van Wassenhove (1993) the whole task of developing a manufacturing strategy is that leaders must relate competencies, developed inside an enterprise, to competitiveness, which is necessary for the market. These changing market conditions are related to a very short life cycle of a new-technology product especially in high-technology enterprises. Besides, high-technology enterprises usually do not perceive the power of the innovations that consumers seek. The most frequent examples are presented of the technological development of computer systems and mobile phones and corresponding changes of consumer demands. For such enterprises the life cycle of technologies may be necessary in order to better perceive the changing market conditions and to adapt the enterprises' technological strategy correspondingly. According to Perez (2004) decisions to implement new technologies are made only by those entrepreneurs, who have sufficient financial resources, but in most cases financing decisions depend very much on potential investments or bank representatives, finance brokers or finance directors of enterprises. The finance directors have a decisive influence on the process of making the decision of investing in new technologies because they manage financial resources and assess possible alternative ways of using these resources.

The performed causality analysis of implementation of new technologies in enterprises allowed to group objectives of implementing new technologies, distinguished by various authors, into two groups that corresponded to internal and external objectives of an enterprise.

Internal objectives of an enterprise:

1. **Creation of a unique product or development of existing products.** An enterprise can produce products (or provide services), provided by a small number of competitors on the market, or it may reach a technological advantage in a specialized area. If products are unique, they can give a competitive advantage and determine bigger business success.
2. **Seek for a technological / competitive advantage.** Development of the technological process, determined by the implementation of a new technology, increases an enterprise's productivity; therefore a competitive advantage in a market is acquired.
3. **Accessibility of specific information sources.** This is information on new most innovative technologies, markets or market situations that is not possessed by other enterprises. Such specific knowledge may be received after performing research; also it may be determined by specific contacts of the enterprise.
4. **A possibility to attract financial resources.** State and EU support creates a possibility for enterprises to realize new ideas and to perform technological innovation investment projects more actively and with more courage.
5. **Increase of technological capacity / possibilities for decreasing production costs.** Prices of raw materials, energy, work, and other production resources differ very much when using innovative and lagging technologies. Many enterprises are stimulated by the possibility to reduce production costs after the implementation of new technologies.

External objectives of an enterprise:

1. **Increased consumer demands.** Consumer satisfaction with production is one of the most important goals of an enterprise. An enterprise has a favourable situation for implementation of new technologies if consumers are receptive to innovations and are ready to acquire them.
2. **Increasing competition in a market.** Enterprises that have not implemented new technologies in time may lose their competitive advantage. The bigger the level of competition in the market is and the more actively enterprises perform innovative activities, the faster processes of implementing technologies in an enterprise change.
3. **Strategic decisions of competitors.** Implementation of new technologies by other competitive enterprises forces an enterprise to perform strategic actions and to implement corresponding or more innovative technologies seeking to keep their competitive advantage or their market share.
4. **Political climate, favourable for innovations.** Actions of implementing technologies in enterprises may be stimulated by state means for stimulating innovative activities (e.g., a set easy VAT, covering of a certain part of costs, a smaller profit tax, etc.).
5. **Rapid technological development (shortening of the life cycle of technologies).** The shortening of the life cycle of technologies determines the time of moral depreciation of technologies. The more enterprises fall behind the technological development level, the bigger investments are needed to catch up with the gap.

So, spectrum of the reasons to implement new technologies is very wide, and the factors determining implementation of new technologies in the particular company can depend on both internal and external objectives of this company. Analysing the situations in more detail, it can be stated that in spite of the fact that accurate evaluation of the changes emerging after implementation of new technologies is not always possible, the main reasons why they are implemented include the objective to increase competitiveness of the company and create an additional value: companies try to consider the decisions of the competitors and behave in the way which would enable to gain an advantage between them and meet customers' needs with lowest costs. It is natural that the aspects mentioned above significantly influence the process of the implementation of new technologies.

Considering the tendencies of the development of the competitive environment, the scientific literature (Gray & Larson, 2000; Ellis & Shpielberg, 2003; Baccarini *et al.*, 2004; Chambers, 2004; Fontes, 2008) highlights these main factors influencing the decision of the companies to implement new technologies:

- **Saturated markets.** Growth of traditional markets has slowed down, and primarily this is related to satisfaction of customers' needs and considerably slow formation of the new needs.
- **Market fragmentation.** Global markets have a tendency to split into smaller niches. Most companies are not able to compete in mass consumption markets
- **Mobile production.** Production departments of the companies are becoming more mobile and scattered all over the world. Modern information and communication technologies determine smooth coordination of these departments as well as the management of all value creation net from the head office of the company. On the other hand, production activities can also be located in geographically concentrated area.
- **Globalization of the markets and investment.** Management of the global value creation net is becoming one of the keystones of company's survival. The task is to be able to manage the international net of partners and customers the most effectively with minimal activity costs and offer customers the value corresponding to their needs.
- **Rapid technological development.** Modern technologies increasingly stimulate work force changing with computer-assisted means of production. However, the use of both information and production technologies is becoming a global phenomenon due to extremely rapid global technological spread which does not ensure a long-term competitive advantage.
- **Shorter life cycle of technologic monopolies.** Investing in the creation of a new technology, the company cannot be sure that the competitors will not be creating even more advanced technology at the same time. This means that the term during which the companies can get return on investment in the creation of new technological processes is becoming shorter.
- **Brand assimilation.** While competition for the reduction of production costs stays intensive, product differentiation is mainly supported with marketing means. Many products, even made by the foremost companies in the world, meet very similar customers' needs, and the choice of these products is more related not to functional or qualitative, but emotional factors of consumption.

- **Constant search of the optimal price-quality ratio.** Recent years have revealed two strategic choices of the companies: orientation to low costs and orientation to exceptional quality. Orientation to low costs is usually related to the companies from the developing countries while orientation to exceptional quality is considered to be characteristic of the companies from the developed countries with high labour costs. Expensive, high-quality production can remain competitive only if it is based on strong innovation processes.

With reference to the statistical data, Lithuanian companies stay behind foreign companies. Most companies hardly implement new technologies, although analyzing different parameters of the competitiveness growth index, it can be noticed that Lithuania show better results in terms of public institution management and macroeconomic environment, but poor results in terms of the implementation of technologies and innovation. With reference to the research carried out by the European Commission (Powell, Moris, 2002), the main reasons determining different rates of technological implementation and development of innovation activities in Western countries are as follows:

1. **Wide spread of different forms of technologies.** Enterprises themselves do not create scientific-technical innovations, but buy the ones already created. This enables to escape the risk and high costs of the creation of innovations, but at the same time it reduces competitiveness of an enterprise.
2. **Increased competition in some developing countries** (China, Hong Kong, Singapore and others). Using imported technologies and local cheap labour force, these countries were able to occupy global markets with competitive products. That is why Western countries have to direct their potential towards unconventional spheres requiring higher scientific-technical potential and experience.
3. **Different legislative restrictions connected with the development of innovation activities.** For instance, tightened legislative restrictions on environment and health care extend the process of innovation implementation and make it more expensive.
4. **Different inflation rates.** Long-term expensive scientific-technical industrial innovations require large capital investment with the payback period of several years, but rapid inflation discourages innovation financing institutions from bearing great financial risk.

Summarizing, it can be stated that successful development of technological innovations is an integral part of a dynamic business management system enabling fast and accurate analysis and absorption of innovation, reorganisation of production processes for the adoption of a new technology or implementation of a new technological process in the company.

Research methodology

For the evaluation of the main reasons determining decisions to implement new technology in Lithuanian manufacturing enterprises, the method of the expert evaluation was used. Applying the qualitative method of the expert evaluation, recommendable number of the experts can range from 10 to 100 people (Makridakis *et al.*, 1998). Competence and impartiality of the experts were considered while making the sample. 30 experts whose activity is related to the creation and development of technological innovations or implementation of new technologies in enterprises were included in the research. Qualification and practical experience of these people allows to treat them as experts in this sphere. The people representing the scientific, business and advisory institutions presented their expert evaluations. The selection of the experts for the research is not random, but directly related to the topic to be researched. The experts were personally provided with the questionnaires, they did not know the structure of the sample and do not have any contacts with each other. Therefore, it can be considered that the experts did not have any impact on each other's opinion.

The data of the expert evaluation was analysed using *SPSS (Statistical Package for Social Sciences)* and *Microsoft Excel* software package. Calculations were made with reference to the methods presented by different authors (Tabachnic, Fidell, 2001; Čekanavičius & Murauskas, 2002; Boguslauskas, 2003; Podvezko, 2005; Bagdonas, 2009) and statistic methods of the research. *Cronbach alpha* coefficient was calculated in order to found reliability of the results of the empirical research and the questionnaire. Considering recommendations of the scientists Malhotra and Birks (2003), the lowest chosen value of *Cronbach alpha* coefficient was 0.6. For the verification of the compatibility of the experts' opinions, Kendall's coefficient of concordance *W* was used. Kendall's coefficient of concordance can range in the

interval $0 \leq W \leq 1$. The value of the coefficient close to 1 means that the experts' opinions are compatible. If $W \leq 0.6$, it means that the results of the expert evaluation are unreliable. Correlation between the variables was researched using Pearson correlation coefficient. Čekanavičius & Murauskas (2002) distinguish between positive and negative correlation: weak positive (negative) correlation is revealed if Pearson correlation coefficient ranges from 0.3 to 0.5 (0.3 to -0.5), and if it ranges from 0.9 to 1 (-0.9 to -1), correlation is considered to be strong positive (negative). The level of significance chosen for verification of the hypotheses is equal to 0.05. Differences of the rates are considered statistically significant, if $p < 0.05$.

Hypotheses and research results

Before application of the method of expert evaluation and the analysis of its results, two hypotheses based on the presumptions of the theoretical research were raised. The hypotheses are as follows:

H1: the most significant reasons, conditioning the development of new technologies in enterprises are: *the increased consumer needs, decisions of competitors and possibilities of cost reduction*.

H2: the most important problematic areas that impede the processes for implementing new technologies in enterprises are: *the lack of financial resources and the passivity of enterprise managers*.

The first hypothesis H1 was based on the theoretical analysis of the reasons why technologies are implemented in enterprises. The reasons, conditioning implementation of new technologies can be quite different, and the factors determining implementation of technologies in particular enterprises can depend on both internal and external forces. With reference to the research, it can be stated that the processes of the implementation of new technologies in the manufacturing enterprises are conditioned by the following factors: the increased consumer needs, rapid technological development, possibilities of cost reduction, strategic decisions of competitors and brand assimilation. This hypothesis was raised in order to find which of the reasons mentioned above are the most important making the decisions to implement new technologies in manufacturing enterprises.

The results of the expert evaluation show that the most important reasons to implement new technologies in manufacturing enterprises are as follows: the increased consumer needs (average evaluation – 3,97 points), strategic decisions of competitors (3,8 points) and possibilities of cost reduction (4,5 points). Summarized results of the expert evaluation are presented in **Table 1**. Verifying the hypothesis about the compatibility of the evaluation ($p < 0.05$), differences were considered to be statistically significant. Experts' opinions on this matter were compatible enough because W was equal to 0,62. So the results of the expert evaluation confirm the first hypothesis H1.

Table 1. Numerical characteristics of the expert evaluation on the reasons of new technology implementation in Lithuanian manufacturing enterprises

No.	Reasons of new technology implementation in enterprises	Numerical characteristics								
		Average	Mediana	Moda	Minimum value	Maximum value	Average squared deviation	Asymmetric coefficient	Coefficient of variation	Kendall's coefficient of concordance
1.	Increased consumer' needs	3,97	4	4	1	5	0,85	-0,29	0,21	0,62
2.	Rapid technological development	3,53	4	4	2	5	0,82	-0,11	0,23	
3.	Possibilities of cost reduction	4,50	5	5	2	5	0,63	-0,89	0,14	
4.	Decisions of competitors	3,80	4	3	1	5	0,76	0,36	0,20	
5.	Brand assimilation	2,03	2	3	2	5	0,85	-0,07	0,42	
6.	The favorable political climate	2,23	2	2	2	5	0,86	0,21	0,38	
7.	Reliable sources of information	2,20	2	3	2	5	1,00	0,02	0,45	

In order to confirm or disprove the second hypothesis H2, the results of the expert estimation were used analogically as for confirmation or disproof of the first hypothesis H1. Theoretical research leads to the presumption that manufacturing enterprises face inevitable complications of the implementation of new technologies in technological sector. Most problematic spheres of the implementation of new technologies emphasized by scientists are the following: lack of information about new advanced technologies, lack of

financial resources, conservativeness of enterprise managers, passivity, lack of staff competence, lack of cooperation among enterprises (with science sector, other enterprises), lack of the government's technology promoting policy, economic instability in the country. The results of the expert evaluation showed that the main problematic spheres the manufacturing enterprises implementing new technologies have to deal with are lack of financial resources (average evaluation – 4,57 points), economic instability in the country (3,97 points) and passivity of enterprise managers (3,6 points). Summarized results of the expert estimation are presented in **Table 2**. Verifying the hypothesis about the compatibility of the evaluation ($p < 0.05$), differences were considered to be statistically significant. Kendall's coefficient of concordance W equal to 0,41 showed that experts' opinions on this matter were quite different.

Table 2. Problematic areas of new technology implementation in Lithuanian manufacturing enterprises

No.	Problematic areas of new technology implementation in enterprises	Numerical characteristics								
		Average	Mediana	Moda	Minimum value	Maximum value	Average squared deviation	Asymmetric coefficient	Coefficient of variation	Kendall's coefficient of concordance
1.	Lack of information about new technologies	2,03	2	1	1	4	0,85	0,77	0,21	0,41
2.	Lack of financial resources	4,57	5	5	3	5	0,82	-1,17	0,23	
3.	Passivity of enterprise managers	3,6	3	4	1	5	0,63	-0,61	0,14	
4.	Lack of staff competence	3,07	3	3	1	5	0,76	0,44	0,20	
5.	Lack of cooperation among enterprises	2,83	3	3	1	4	0,85	-0,51	0,42	
6.	Government's technology promoting policy	3,57	4	3	1	5	0,86	-0,65	0,38	
7.	Economic instability in the country	3,97	4	5	2	5	1,00	-0,53	0,45	

The results of the expert evaluation partly confirm the second hypothesis H2 because economic instability in the country, which was not mentioned in the hypothesis, was indicated by the experts as the most important problematic sphere alongside with the lack of financial resources.

Conclusion

1. The research carried out indicated the fact that in the recent years, the connection of industrial progress, scientific research works, organizational changes and economic competitiveness has increased. One of many significant changes in technological and economic environment of industrial enterprises is related with the increasing dissemination of technological innovations and commercial profit, obtained having implemented new technologies in industry. The competitiveness of enterprises and the state is directly dependent on their ability to acquire and implement new business methods and new technologies, as well as use them in the production of new competitive products.
2. The causality analysis of new technology implementation in enterprises provided a possibility to single out the main reasons that influence strategic decisions for the implementation of new technologies in enterprises. They are: saturated markets, market fragmentation, mobile production, globalization of markets and investments, rapid development of technologies, decreasing lifecycle of technologies, brand convergence, and constant search of the optimal ratio of quality and price.
3. The results of the expert evaluation states that the aim of the expert study was achieved and the peculiarities of the main reasons determining decisions to implement new technology and the main problematic areas of this process in Lithuanian manufacturing enterprises were evaluated. The hypothesis H1 (*the most significant reasons, conditioning the development of new technologies in enterprises are: the increased consumer needs, decisions of competitors and possibilities of cost reduction*) formed in the empirical study, was proved, and H2 (*the most important problematic areas that impede the processes for implementing new technologies in enterprises are: the lack of financial resources and the passivity of enterprise managers*) was proved partially.

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