

## DIFUSSION OF TECHNOLOGY IN SMEs

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### **Abstract:**

In a knowledge economy the most important resource is exactly the knowledge. The way in which it contributes to accelerate the development derives from the process of technological diffusion. Based on theoretical notions regarding the innovation and technology diffusion we conducted an exploratory research with the purpose of identify: (i) The reasons for which SMEs conduct projects of technological development; (ii) The ways and means to promote the innovation process; (iii) The structure and particularities of the human resource involved in the absorption and diffusion of technology in a county from Romania. The specific theme of the paper is the predisposition of SMEs in industry for adoption and diffusion of technology. Study results suggest that the production companies that were analyzed adopt a strategy of incremental innovation on organizational and process level. This happens naturally, regardless of the policies practiced by the State. One important finding linked to the absorption process of new technologies, in the case of the studied companies, is that they managed to secure their production growth and the quality of their products in high profitability conditions. It was also found that there are a small number of production companies which adopt new technologies in order to develop innovative products. Because in the industrial sector analyzed were not done so far any studies that deal with the process of technological diffusion, we can conclude that our work provides an “gateway” for future research based on the conclusions of the study as suggested in the specialized literature.

*Keywords: technological diffusion, innovation, technology, technology management*

## 1. INTRODUCTION

To understand the origin of technology that leads to progress through innovation is important not just for the ones who want to understand the effect of technology, but also for the ones who study its function in society. Technology itself is a practice based on creating products (goods or services) of an ever increasing effect. According to Suh (2001) in engineering literature the process of creating is seen as a process made up of a series of translation steps. In the beginning there come the necessities and demands of the customer, these ones leading inevitably to technological development.

As Pelc (2004) remarks too, there are multiple conceptions of the term "Technology". The actual definitions have mostly a high degree of dependency on the approached area or even on the approached subject. The differences between the definitions lead or may lead to confusions. Even the various professions have different views of the concept of "technology".

The economists approach and see technology in the context of productivity and utility. The economical approach of technology leads to its impact on leaving an economical system.

The sociologists approach technology like a process that creates relationships among people, brings welfare, creates opportunities, expectations and menace upon the society.

The engineers and experts in designing systems connect technology with skillfulness, facilities, methods and tools which allow turning the ideas into functional and useful products, into processes and systems.

Technology can be considered as a science of fabrication methods and facilities that attempt to transform the raw material into products in easy economical circumstances. It must be considered the fact that the transformation has to be done at a price accepted by the market. A technology proves its utility when the final result is certain, success bringer, achieved in controllable circumstances, reproducible and extreme-defined (Abrudan I, Căndea D, *et al*, 2002).

Nobody can deny that in this very moment the progress of humankind depends on the way in which technology evolves. But technology too depends on science and we are witnessing now a totally new innovation pace.

From the desire of knowing better the phenomenon of technology's diffusion in Maramures county for underlying a future development strategy suggested by the Maramures County Council, through the Centre of research, Innovation and Technology Transfer NORDTech®, I presented the project called "The diffusion of technology and the inferences of this project in the economical development of Maramures county". The total amount of the financing given by the contract number 5240 from 13.08.2013 was adequate for effectuating a sectional exploring study.

The project, built according to the requirements of the qualitative research methodology and keeping the standards known by the academic community, proposes to indentify the degree of technologic diffusion among the economic agents from Maramures County and to determine the relation among the organizations which are adapters of new technology and the organizations which diffuse innovative technology.

## 2. TECHNICAL PROGRESS, INNOVATION AND DIFFUSION OF TECHNOLOGY

For almost two centuries since Adam Smith wrote the well-known "The Wealth of Nations", the technical progress played a role in projecting the economic theories only in extraordinary cases. Paradoxically, this work was finished during the "industrial revolution" when the new discovered technologies helped exactly to apply the theories that were posited in practice. According to Pasinetti L. (1999), the acknowledgement of the importance of technical progress in developing the global economy takes place after the World War II.

The technical progress is (J. Schumpeter, 2011) the motive power of economical expansion and represents the set of innovation activities of the producing area, using the scientific research and especially the applied research as basis. It appears as a set of activities through which the volume of the knowledge from the area of research- development is practiced and transferred in social-economic practice.

In some works (Ciobotaru V. *et al*, 2001) the technical progress is shown as the technical level rising of material components of the work process, technological processes and of the products, beginning from the research- development, as an amount of activities like the ones of conception, projection, assimilation and introduction in production of the most new scientific knowledge.

If we consider the constitutive, the purposes and the support of achievement of the technical progress we can present the next structure:

**Table 1:** The structure of technical evolution

<b>Steps of execution</b> In the beginning In the end	<b>Activities</b>	<b>Purposes</b>	<b>Support of achievement</b>
CONCEPTION AND CREATION	Scientific research - fundamental	<u>Underlies:</u> <ul style="list-style-type: none"> <li>• new laws;</li> <li>• new possibilities of acceding to the social demands;</li> </ul>	<ul style="list-style-type: none"> <li>• Documentations</li> <li>• Researches</li> <li>• Experimentations</li> </ul>
	Applied	<ul style="list-style-type: none"> <li>• new applications/solutions;</li> <li>• improve the existing knowledge</li> </ul>	<ul style="list-style-type: none"> <li>• Researches</li> <li>• Experimentations</li> <li>• Technical documentations</li> </ul>
	Technological engineering	<u>Develops</u> solutions/ technical means of practical embodiment of the scientific research for: <ul style="list-style-type: none"> <li>• execution of new technologies/product;</li> <li>• updating technologies / existing products;</li> </ul>	<ul style="list-style-type: none"> <li>• Technological construction projects</li> <li>• Experimental models</li> <li>• Pilot plants</li> <li>• Test engines</li> </ul>
RECEPTIVITY IN PRACTICE	Preparation for production	<ul style="list-style-type: none"> <li>• designing and homologating technologies</li> <li>• making SDVs</li> </ul>	<ul style="list-style-type: none"> <li>• Technological projects</li> <li>• SDVs construction</li> <li>• Zero series construction</li> </ul>
	Production	<ul style="list-style-type: none"> <li>• Making up of new/updated products</li> <li>• Insuring quality for the customer</li> </ul>	<ul style="list-style-type: none"> <li>• Works specific to production</li> <li>• Service works</li> </ul>
TECHNOLOGY'S DISPERSION (in use)	Use	<ul style="list-style-type: none"> <li>• Usage of new/updated technologies/products</li> </ul>	<ul style="list-style-type: none"> <li>• Specific works</li> </ul>
	Maintenance and repairs	<ul style="list-style-type: none"> <li>• Keeping the new/updated technologies/products in an optimum usage condition</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance works (service, repairs, updates)</li> </ul>

Source: Adapted after, RUSSU, 1984

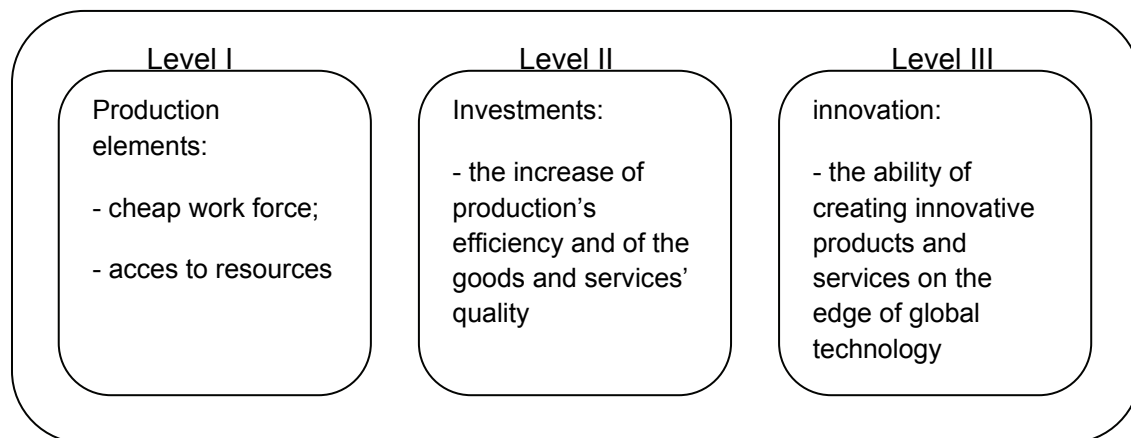
According to J.Deschamps and P.Nayak (1995) the branch leader businesses, judging by the rate-of-rise and profit, gain 49% from earnings from some products brought in the last five years, while the

weak businesses only 11% from earnings from products like these. For the extremely innovative companies, the percentage could be much higher. How valid is this statement after 20 years?

The Hungarian researcher Kornai János (2010) considers that now, there are not enough parameters and ways of measuring the effects of the technical progress upon the day by day life. Even the European Union supports this idea, considering that the GDP is no more a complete parameter, sufficient for measuring the progress (HotNews.ro, 2009). In the work "Technical progress, quality and standardization", the authors (Ciobotaru et al., 2001) consider that the complex process of the technical progress influences through the peculiarities of its activities, both the material and the spiritual elements of human society. The main form of progress' manifestation is made by means of innovation.

Michael Porter (2003) presented a scheme of economic competitiveness based on three steps that can be outlined like this:

**Figure 1:** Porter's model of economic competitiveness



The challenging advantage of economic companies owed to innovation is an undisputed matter. The big companies world-wide have a thing in common: the fact that their absolute success comes precisely from innovation. While the challenging advantage could come from the amount of or from holding assets, it becomes more and more obvious that the market encourages those companies that can gather technologic knowledge and abilities which have proficiency in bringing changes in their offers, whether it is about product or service (Kay, J., 1993).

This thing can be seen not only at the same level with the sole proprietorship, but in the given background, it plays the part of economic increase nationwide. For example, the Parliamentary Office of Science and Technology saw the "the conversion of the ideas and knowledge in products and services as the engine of modern economy". (OST, 2000) Innovation contributes in many different ways. For example, evidences given during some research prompt a strong bound between the market performance and the new product (TIDD, J., 2000, Souder, W. și J. Sherman, 1994).

The process of innovation's diffusion depends on the characteristics of the innovation, on the innovators themselves and on the extern agents (Wejnert, 2002). Rogers (1995) gives an explanation of the process of embracing an innovation broad approved from a social point of view. This one is defined as "a process through which an innovation is being sent among the members of a social system by means of specific ways of communication".

This approach is similar to the type of communication of Shannon (1948). According to this theoretic point of view, the embracement is part of a five steps process:

1. become aware of the innovation
2. interest
3. evaluation
4. attempt
5. embracement by the user

The embracement process of new technologies by the companies must have the grounds in the evaluation of both the hardware and software features of both technologies, not only the substituted technology, but also the substitution technology (Schiavone, F., și MacVaugh J., 2014).

### 3. METHODOLOGY

The reasons that underlay the choice of the study matter were:

- the technology degree of the economic agents with activity in production in Maramures county and the way of their positioning towards the cutting-edge technology is not known (producer or adapter of technology);
- specific classification criteria of the technologies that are used and diffused by the economic agents from Maramures county are not found.

The study was developed using the method of explorative, qualitative sectional research, implying the semi-structured and semi-directive depth interview. During some dialogues with the members of the project team, because of the quite limited degree of knowledge of the approached matter and from the desire to create disclosures of the general character of the matter, on the strength of these new assumptions of further research could be created, I considered that explorative research the most suitable for this.

Because of the phase I was in back during the doctoral study, namely during the initial phase of studying the approached matter, i have chosen to follow the research typology presented by Boier, R., and Țimiraș, L., (2006) choosing the qualitative research as a result of the type of the given information.

The sectional nature of this study implies that the results presented in the next sections are valid at the moment of its execution. In a figurative representation, these results can be compared with a image of the existing situation.

The reasons that underlay the decision to use the individual semi-structured and semi-directive depth interview as a research tool came from the desire of imprinting a professional nature on the entire research process. Therefore, within the research project, alongside with my colleagues, we built an interview guide that included the subjects that were to be approached during the discussion and a set of precepts that were respected by the operators of the study.

We began from the premise that the production companies from Maramures County deliver hi-tech products through the cutting-edge technologies, using innovative management, marketing and mastering methods.

In the given study, we used both primary data obtained through research straight to the economic agents, and secondary data placed at audience's disposal. The chosen observation body was the organization. The observation bodies are part of the economic agents who work in production and who unfold their activities in Maramures County.

The criteria of selection which underlay the choosing of the pattern are:

1. The past collaboration with the university
2. Notoriety within the community
3. The opening of the executive board of the economic agents to participate in the study.

Therefore, a list with 156 economic agents was made. 130 from these were met, while the rest had incomplete or not updated contact information. A number of 50 companies participated in the study, the geographic location being a challenge that we succeeded to accomplish. The approaching of the companies was made by phone, on the grounds of a preset script.

## 4. ASPECTS CONCERNING THE DIFFUSION OF TECHNOLOGY IN SMEs

### 4.1. Establishing the predisposition and the level of the economic agents to renew, adopt and diffuse the technology.

#### *Innovative process*

After making the interviews it can be said that the innovative process is encouraged integral in the studied observation bodies, regardless of their field of activity. This encouragement takes different forms, from case to case. The most frequent ones are the financial rewards and advancement on a superior function.

Nevertheless, there are extreme situations too, where appears the obligation of the employees to come up with at least two resolutions to improve the activity each year, or for the one of the studied companies it is being asked at the top level of the management the transposition of a process or organizational innovation, which has to produce economic effects. It is regarded mainly the adjustment of the exploiting expenses of the named association. Otherwise, according to the concluded management contract, it could get even at its dissolution.

In fact, within the observation bodies the innovation is present in all the activities from corporations, without being just about products and technologies. It also targets information systems, economic methods, organizational structures, decisional processes, etc.

Even though at least at a declarative level, the innovation is encouraged in each studied observing body, this process is somehow chaotic, but in one case I identified the presence of a well-defined strategy of the respondent of the innovation's management and technologic development.

*„The investment in research and innovation is worth making when you have a well-established path”*

When it comes to the real results of the innovative process of the intellectual property, half of the studied observation units stated that at this time they own available.

#### *Taking up new technologies: advantages and disadvantages*

For the most of the studied observation units the main advantages given by the process of taking up some new technologies are:

1. increasing the productivity
2. increasing the quality of the products
3. increasing the efficiency of the company

The last one contains: increasing the profit, adjusting the costs, energy and fuel savings.

Other advantages mentioned by the respondents were:

- Improving the price/quality proportion of the own products
- Adjusting the costs with the work force
- Making the difference towards the competitors

When it comes to the disadvantages of the process of embracing new technologies, the main tendency was to pinpoint the low education of the human resource which is hereby incapable to work with the new machines.

#### *The diffused technologic products*

The participants in the study named their own products offered to the market as (arranged by their recurrence):

- Innovative, according to the demands of the market
- Products that respect the present standards in the field of activity
- Complex products, adapted to the needs of the customers
- "Hi-tech products"

There was a case when the respondent said: "We create innovative products too, but we mainly go for the serial ones. For the first ones we don't have market because of the high costs".

#### **4.2. Establishing a minimum of three criteria and levels of classification of the economic agents according to the technology they use**

Because in the bibliographic study we have made we did not find any reference to a possible classification of the production systems by the degree of technologic equipment, we considered the direct interviewing of the observation units useful regarding this aspect. We also tried a technologic positioning of the companies from Maramures.

Thus, through the self-evaluation process the respondents gave the following answers:

- Adequate to the present needs
- At a high level / top technology
- Medium degree of technology
- Enough technology related to the level of demands

One can thus notice a positioning of the researched production systems somewhere at the boundary of necessary for optimal operation.

The criteria according to which the respondents created the classification are (in the order of their recurrence):

1. in accordance with the technology existent with direct competition
2. in accordance with the technology available on the market at a given moment

One interesting classification criterion used by one of the respondents was: "*from the point of view of the technological knowledge held by the company*"

#### **4.3. The structure of the human resource involved in the absorption and diffusion of technology in the Maramureş County**

The sketch of the employee involved in the processes of purchasing new technology, as well as in the promotion and commercialization of the products created with the researched production systems is the following:

An individual aged 25-35, with higher education in the field of engineering, or at least student. Amongst the most important features of these individuals, the following were mentioned by the respondents:

- respect for the job
- desire to learn throughout their professional life/self-taught
- creative
- dynamical
- loyal to the company
- good knowledge of the company's field of activity
- proactive – solution seeker

These individuals, very often attend training courses offered both by the company which employs them and by another course supplier.

To the question "How do you treat the innovative individual in your company?" all researched observation units answered that they recognize and reward his/her contribution to the development of the organization (either financially, or through promotion to a superior position). There are nevertheless approaches which accept a certain degree of tolerance to mistakes or which have provisions in the company policy regarding the amount of the financial rewards given in accordance with the importance of the innovation (applicable locally: 1,000 lei, nationally: 2,000 lei, and at group level: 5,000 lei).

The most interesting response for this question was: "*With maximum seriousness, as my own brother!*"

#### **4.4. Identifying the companies which achieve absorption, innovation and diffusion of technology based on technological development projects**

Most interviewed subjects started technological development projects within the past 5 years either from their own funds or from other sources (financing funds, credits, governmental agencies or other financial bodies). Thus, the main advantages of development projects, in their opinion, are: increase of competitiveness, safety of their own products in use, reliability of the equipment in use with high degree of safety, opening of new markets, increasing the production capacity, capital infusion, increase of quality, reduction of the execution time, increase of the degree of satisfaction of the needs of customers, increase of the turnover and the number of employees, increase of the added values of the end product.

One of the respondents stated that *“due to the implementation of the project of technological development he succeeded in creating an advance of 4-5 years as compared to the company’s normal rhythm of development”*.

As regards innovations in marketing achieved by the researched observation units, these are almost non-existent. Only one respondent mentioned the fact that they have a partnership with a company in the United States of America specialized in marketing consultancy, while another company admitted to using the „below the line” (BTL) type of on-line marketing exclusively.

There are respondents who mentioned from the beginning that they do not innovate in the field of marketing, while others presented as marketing strategies the following: references from clients, building their own brand name, building a marketplace culture, permanent meetings with prospects, direct marketing, participation in fairs and exhibitions.

### **5. CONCLUSIONS**

This study needs to be viewed as radiography of the productive sector in Maramures, which intends to identify the current tendencies in the field of diffusion of technology at the end of 2014 – beginning of 2015. Thus new lines for research on the general nature of the issues have been opened, based on which new hypotheses for further research will be drawn up.

The hypothesis from which this study began, according to which *“production companies in Maramureş deliver hi-tech products using modern technologies, innovative management, marketing and organizational methods”*, was partially confirmed. At present, base on the outcomes of the research, we can state that:

*Production companies in Maramureş deliver innovative products using modern technologies, adequate for the current needs, adopting an incremental innovation strategy at organizational and process level.*

Starting from the development strategy of the county of Maramureş we can notice that the strategic objectives taken on for the period 2007 – 2013, with regard to the consolidation and development of the productive sector have been reached. One still needs to research though if this was achieved due to the interventionism of the local authorities or if we are dealing with a natural effect generated by the self-regulating mechanisms specific for the market economy.

The outcome of the research was that the openness of the Maramures production systems towards supporting and promoting innovation is clear. It is done by each organization through methods specific to their field of activity. Yet the most commonly used instrument is the financial reward, common to all observation units.

According to the analysis of the information made available by the participants at the study, one can state that the tendency in the county of Maramureş regarding the degree of technological equipment meets the requirements of the marketplace with regard to satisfying the needs of the customers. Moreover, the products diffused by the studied production units within our county are complex, highly innovative products, adapted to the current requirements.

Through the process of absorption of new technology, Maramures companies succeeded in ensuring an increase in production and the quality of the products while improving their economic efficiency at the same time.



## REFERENCE LIST

1. Abrudan, I., Căndea, D. (coord.) (2002). *Ingineria și managementul sistemelor de producție*. Manual de Inginerie Economică. Cluj-Napoca , Editura Dacia.
2. Boier, R., Țimiraș, L., (2006). *Cercetarea de marketing*. Ed. Performantica, Iași.
3. Ciobotaru, V., Angelescu, A., Vișan, S. (2001) *Progres tehnic, calitate, standardizare*, București, Editura ASE,
4. Deschamps, J. and Nayak, P. (1995), *Products Juggernauts*, Ed.Harvard Buss. School,
5. Kay, J. (1993). *Foundations of Corporate Success: How business strategies add value*. Oxford, Oxford University Press,
6. Kornai, J., (2010) Inovație si Dinamism: Despre interacțiunea dintre sistemele economice și progresul tehnic, *OECONOMICA* nr. 2, Retrieved from <http://www.kornai-janos.hu/Kornai2010%20Inovajie%20si%20Dinamism%20-%20Romanian%20-%20Oeconomica.pdf>
7. Măsurarea progresului: CE propune indicatori ai calității vieții și mediului, în locul PIB-ului, (2009, august 31) Retrieved from <http://www.hotnews.ro/stiri-esential-6098040-masurarea-progresului-propune-indicatori-calitatii-vietii-mediului-lucul-pib-ului.htm>
8. Office of Science and Technology, (2000) *Excellence and Opportunity: A science policy for the 21st century*. London.
9. Pasinetti L.(1999) Economic Theory and Technical Progress, *Economic Issues* 4(2), Retrieved from <http://www.economicissues.org.uk/Files/1999/299aEconomic%20Theory%20and%20Technical%20Progress.pdf>
10. Pelc K. (2004). On Adam Smith and a Theory of Technology, *Presented by International Association for Management of Technology*, Retrieved from <http://www.iamot.org/conference/viewabstract.php?id=745&cf=4>
11. PORTER, M., (2003). Building the Microeconomic Foundations of Prosperity: Findings from the Microeconomic Competitiveness Index, în *Global Competitiveness Report 2002-2003*, World Economic Forum, Geneva
12. Rogers, E.M. (1995) *Diffusion of Innovations*, 4th ed., The Free Press, New York.
13. Russu, C., (1984). *Progres tehnic – eforturi, efecte, eficiență*, București, Ed. Politică.
14. Schiavone, F., and MacVaugh J., (2014) A user-based perspective on limits to the adoption of new technology, *Int. J. Technoentrepreneurship* Retrieved from [https://www.academia.edu/196013/A\\_user-based\\_perspective\\_on\\_limits\\_to\\_the\\_adoption\\_of\\_new\\_technology](https://www.academia.edu/196013/A_user-based_perspective_on_limits_to_the_adoption_of_new_technology)
15. Schumpeter, J (2011). Poate supraviețui capitalismul? Distrugerea creatoare si viitorul economiei globale, București, Ed. Publica.
16. Shannon, C.E. (1948) A mathematical theory of communication, *Bell System Technical Journal*, 27 July and October, pp.379–423 and pp.623–656.
17. Souder, W. and J. Sherman (1994) *Managing New Technology Development*,. New York, McGraw-Hil.
18. Suh, N. P. (2001). *Axiomatic design: advances and applications*. Oxford/New York: Oxford University Press.
19. Tidd, J. (ed.) (2000). *From Knowledge Management to Strategic Competence: Measuring technological, market and organizational innovation*. London, Imperial College Press.
20. Wejnert, J. (2002) Integrating models of diffusion of innovations: a conceptual framework, *Annual Review of Sociology* 28, pp.297–326.