ESTABLISHING THE STRATEGY FOR RESEARCH AND DEVELOPMENT (R&D) OF SMES IN THE "NONCONVENTIONAL TECHNOLOGIES" (N.T.) FIELD USING "NEURAL NETWORKS" - (NN)

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ABSTRACT: The paper referes to the possibility of using neural networks in selecting the "R&D" strategy, in the nonconventional technologies field, presenting a selection and the main key elements of the Research and Development (R & D) strategies, applicable in the nonconventional technologies (NT) field. It also refers to the possibility of using neural networks ("NN") up to the level of taking managerial decisions regarding the manufacturing processes and into establishing the future strategy of a company.
KEYWORDS: strategy, indicator, artificial network, neural network, artificial intelligence, management, research-development

1. INTRODUCTION

In practice it is quite difficult to reach a clearly defined R&D strategy in the NT field; it is determined by a continuous process of evaluation and analysis of interdependencies between these factors: organizational strategy, environmental conditions, the organization's potential and the R&D papers' portfolio in the "NT" field.

Therefore, there is no question of an exclusive choice of a strategy, but rather a decision of the direction to follow, the result of a combination of strategies to varying degrees, corresponding to market requirements, the industrial development cycle and the product's life cycle.

2. STRATEGIES APPLICABLE IN THE "NT" FIELD

The main starting point of the management impact moments is the important area of the scientific research, where the management action directions are explained by the considered types of strategies:

a. **the offensive strategies**, characterized by high risk, high compensation potential in terms of financial results obtained as a result of assuming a risk, high potential in technological innovation, competence to analyze the market and of realizing commercial products;

Although, theoretically, these successful offensive strategies are adopted, especially for large industrial organizations, they can also be used successfully for small and medium organizations.

The large organizations, with high economic potential, can strongly support a R&D department in the "NT", but are often strongly motivated by those products and technologies that can make a substantial contribution to its profits and look less favorably at the new products that require a longer time to reach a substantial volume of sales.

The small organizations can easily adopt some offensive strategies of the R&D in the "NT" field, because of the fact that the same profit, which for a large organization is only part of the total, at the small organization it brings a contribution relatively much more important in the overall level of profitability. These organizations often provide more favorable conditions materialized in management style and leaner organizational structure, opportunities to focus its own resources, at some point, through a single project.

b. **the defensive strategies**, characterized by low-risk and low compensation potential, are suitable for those industrial organizations able to make a profit in conditions of strong competition, through the ability of controlling some of the market. This type of strategy is recommended to those industrial organizations with better results in the production and marketing than in the R&D field.

c. **the acquiring strategies** (purchase of licenses) at which two aspects can be considered:

- purchase of licenses which presents, at one time, the opportunity to earn commercial gainings, by buying the results obtained from

the R&D investment of other companies. This is because it usually obtains a small gain through the rediscovery through R&D in "NT" field of what was obtained from another cheaper source.

- patenting some of its major innovations: represents a support strategy for small companies and a convenient strategy for large companies;

d. **the interstitial strategies**, which have as main condition for applying the knowledge of the strengths and weaknesses of competitors; As a result, this type of strategy stems from the deliberate attempt to avoid direct confrontation, by analyzing and exploiting the weak elements in the R&D field of the potential competitors on the market and exploiting them when they match their strength items.

e. **the "incorrect" strategies**: the application of new technologies in the industrial organization has great experience in developing new products whose market is owned by other companies. These strategies can not give favorable results, constant over time, unless they are also supported by an offensive strategy that maintains their won position.

The main factors to be taken into account in formulating the R&D strategy in the "NT" are:

A. The technological prognosis on the environment in connection with the managerial strategy of the industrial organization treated in the strategic planning; it aims the following requirements in "N.T." field:

- the phenomenological analysis and the new economic processes;
- formulation of realistic development options;
- ensuring a dynamic balance between the goals of permanent evolution and the level of resources.

The strategy which refers to R&D in the "NT" field, which can be seen as an extension of the strategic planning process, is using the technological forecast in a similar way, in the following areas:

1) identifying future competitive threats and maintainance chances and the expansion into new markets;
2) avoiding the competition's surprises;
3) the major reorientation of the industrial organization's politics in the following directions:
   - identifying new technologies;
   - changing the industrial development strategy in the R&D field;
4) the improval of the operational decision-making in the directions:
   - R&D portfolio;
   - selection of projects for R&D;
   - allocation of resources;
   - personnel policy.

In conclusion, we can say that all industrial organizations which have as object of activity and the introduction, the use or research in the "NT" field, will have to adopt some form of technological forecast, market-oriented, and the amount of effort for implementing these techniques must take into account the following:

- the rate at which changes occur in the economic environment;
- the planning horizon;
- the managerial strategy of the organization;
- the creation and production potential of the organization;
- the proven and potential resources that are available.

B. The risk-compensation relationship

R&D should consider the risks arising both in addressing the entire set of "NT" projects and individual projects. Inherent risk occurs in the global approach of the "NT" problematic and is divided into the projects' crowd at a certain level. Therefore, in a company focused for example on "NT" research, both the offensive and defensive strategies can be applied, depending on each project.

After "analyzing the risk", it results that the large industrial organization, able to relate risk to a large number of R&D projects, can favour an offensive strategy, while a small company, because of the fact that it performs a limited number of projects, should focus, at first glance, towards a defensive strategy.

However, taking into account, in the smaller companies, the informal managerial style, the simple organizational structure (which avoids the hierarchical dilution of the willingness to accept the risk), the possibilities to concentrate the efforts at a particular time towards a product- project, the risk awareness, it can be said that the small companies, either research or production in the "NT" field, may adopt an offensive strategy.

Subsequently, the management decision (Figure 1) [5] can have two contradictory reactions:

- the decision to transfer the R&D effort fast, in the "NT" field and reducing the attempts to bring the classical technology closer to the upper limit of the performance;
- the decision to invest the bulk of capital in the existing technology.

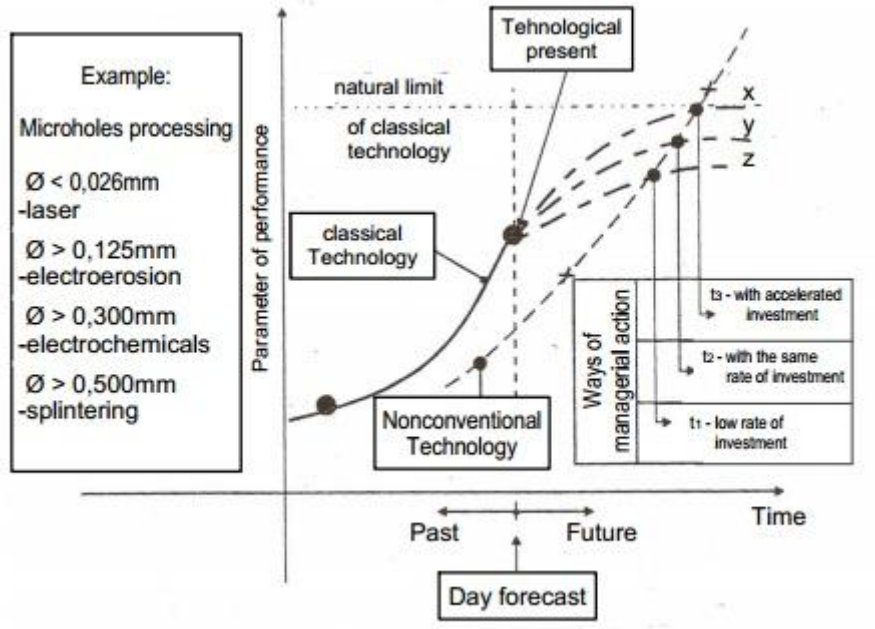

Figure 1. Establishing the management decision

According to Figure 2, the evolution of the life cycle of a particular nonconventional technology results as a synthesis of the life cycles of the components. They evolve by the same law, but there is a certain hierarchy, according to their share when developing this technology.

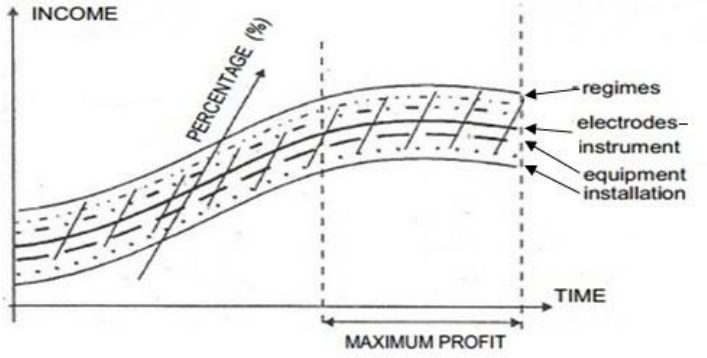

Figure 2. The evolution of the lifecycle of a nonconventional technology

For small companies (Figure 2) specialized either in production or in R&D in this area, with a limited material base, it is considered that the design and the construction of the related tools and the used operating modes, have the decisive influence over the technologie's rentability, while for the large, specialized, companies, the ranking may be different.

In these circumstances, the companies must predict the evolutionary way of the commercial launch's lifecycle of a technology, for establishing the moment of action in order to enhance, so that it withstands the competitive market.

This prediction consists in determining the nodal point in achieving the maximum corresponding to components for determining the timing of action on each one (Figure3).

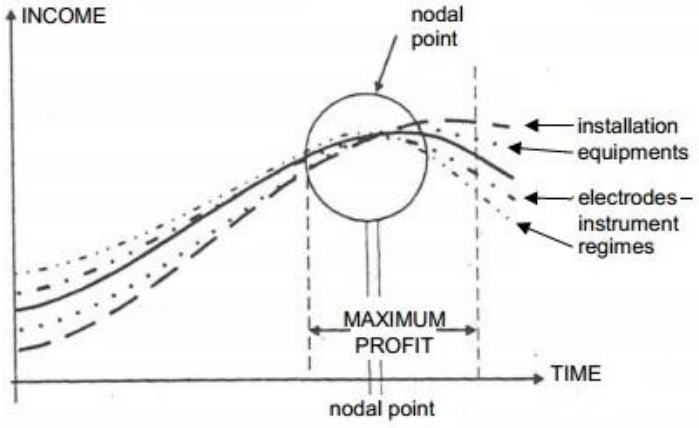

Figure 3. Determination of nodal point

Considering that the four action courses over the "nonconventional" product's life cycle are being reduced to two main directions: I-conceptual direction (embedding specialized facilities and equipment); II- user direction (embedding processing tools and schemes), the analysis of the life cycle curve highlights both the preponderance of the first and creating the premises of any local or general monopoly.

Determining the moment of the nodal point can be achieved depending on the specifics of each company, correlated with its involvement in the two strands, given the inherent difference between the two absolute maximums.

The correct analysis of the life cycle of the unconventional technology allows the establish of the optimal strategy for the company, both for for extending the profit period, and in the conditions of the analysis of some similar competitive products of

the directions of action, in order to maintain and extend the marketplace with its own products.

3. POSSIBILITIES OF USE OF THE "N.N." IN ESTABLISHING THE DEVELOPMENT STRATEGY OF SMES WITH ACTIVITY IN THE "NT" FIELD

A selection and the main items of the R-D strategies applicable in the nonconventional technologies field are being presented and also the specific elements to analyse such a methodology, together with the possibility of using "NN" up to the managerial decisions level towards the manufacturing processes.

The three parts that form the neuron (Figure 4) are: *cell body, dendrites and axon* [2].

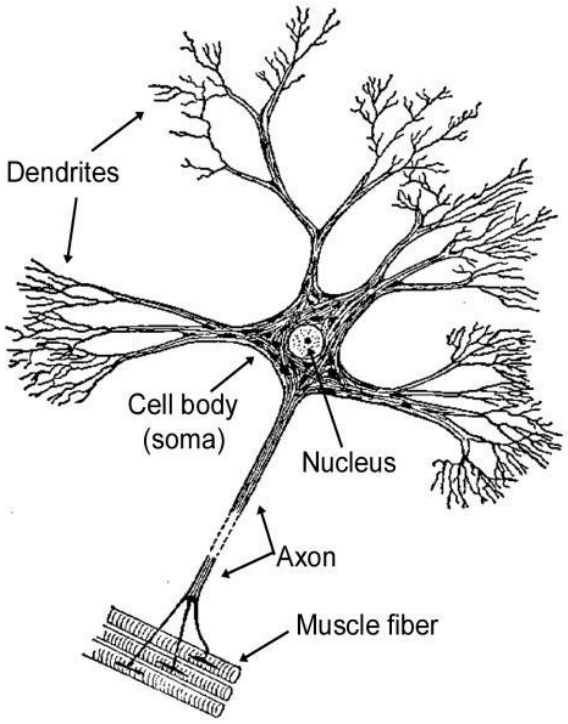

Figure 4. Components of a neuron
Source: (Dzitac, I.- Artificial Inteligence, Aurel Vlaicu University Publisher, Arad, 2008)

The artificial neuron (Figure 5) [2], is a lot more simplified copy of the biological neuron and it represents the basic structural and functional element of the distributed information processing systems that mimic the operation of a biological neuron, with strong connectivity properties. [3]

It is composed of a body, a set of *n* inputs and one *y* output. The *x* inputs are signals coming from other neurons or from the outside world and are represened through real numbers *x1, x2, ..., xn*.[2]

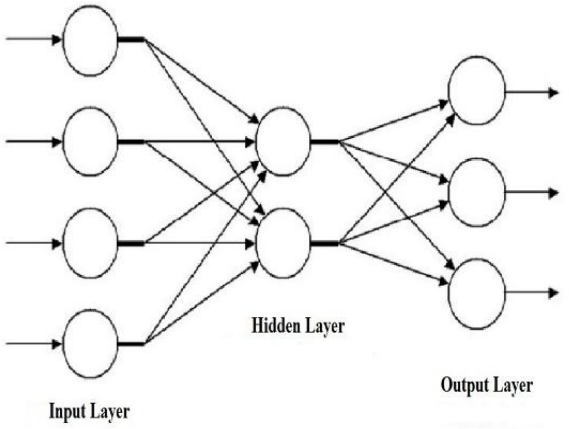

Figure 5. Artificial Neural Networks
Source: (Dzitac, I.- Artificial Inteligence, Aurel Vlaicu University Publisher, Arad, 2008)

In the presented context, "NN" may be particularly useful in forecasting the future strategy of joining the network (indications) (Xn) and the corresponding outputs (proposed strategy-Yn) being highlighted in the table (matrix) 1 and Figure 6.

Table 1. Analysis indicators for the selection of the strategical variant using the "NN"

Strategy / Indicator	Offensive -A-	Defensive -B-	Absorbance -C-	Interstitial - D -	Incorrect -E-
a. risk	high	low	low	medium	low
b. compensation potential regarding financial result	high	low	high	low	medium
c. potential in technological innovation	high	medium	high	low	medium
d. the competence to analyze the market	high	high	high	medium	low
e. the competence to concrete commercialize the products	high	high	high	medium	low
Note: Each indicator will receive a score between 0 and 1, the allocated share being established by the analyst					

An example of allocating the numerical values of the indicators (X1 ... Xn) for different variants for choosing the future development strategy (Y1 ... Yn) is presented in Table 2.

Table 2. Values assigned to the analysis indications with "NN"

Strategy / Indicators	Offensive -Y1-	Defensive -Y2-	Absorbance -Y3-	Interstitial - Y4 -	Incorrect -Y5-
X1 risk	[0,3…0,4]	[0,1…0,2]	[0,1…0,2]	[0,2…0,3]	[0,1…0,2]
X2 compensation potential regarding financial result	[0,1…0,2]	[0,1…0,2]	[0,1…0,2]	[0,2…0,3]	[0,2…0,3]
X3 potential in technological innovation	[0,1…0,2]	[0,2…0,3]	[0,1…0,2]	(0…0,1]	[0,1…0,2]
X4 the competence to analyze the market	(0…0,1]	[0,1…0,2]	[0,1…0,2]	[0,1…0,2]	[0,1…0,2]
X5 the competence to concrete commercialize the products	(0…0,1]	(0…0,1]	[0,1…0,2]	(0…0,1]	(0…0,1]
Note: for each Yn: min ∑Xi = 0,5; max∑Xi=1					

The value of min ∑Xi represents the capacity to analyse the topmanagement in a first phase, the capability of the institution to approach different strategies. The range Xi Є [0,5…1] and, implicitly, the max ∑Xi=1 value give the opportunity to apply the principles of any of the strategies taken in the analysis.

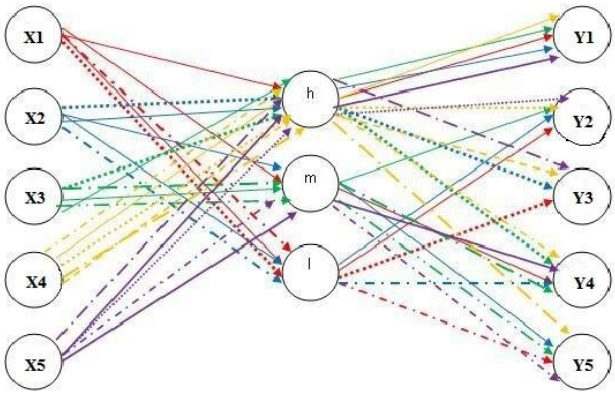

Figure 6. The neural network for establishing the strategy

4. CONCLUSIONS

The strategic thinking translated into a neural network through the input elements, must take into account the specific elements of the moment of decision regarding the future strategy of the company.

In these circumstances, the use of Neural Networks- which is, nevertheless, a method of prognosis- is determined by all the information of the topmanagers in the field in which it is desired a scientific prognosis determined on the basis of basic elements, such as:

- the establishment of technological advance;
- advantages specific to the precursor;
- disadvantages reported by the precursor.

Establishing with the aid of Neural Networks of the future strategy (offensive, defensive, absorbance, interstitial, incorrect) can be achieved by considering a number of entries like:

- the compensation potential concerning the financial result;
- the potential in the technological innovation;
- the ability to comercialise the products.

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