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SOME PROGNOSIS METHODS APPROPRIATE FOR STRATEGIC MANAGEMENT OF ORGANIZATIONS ACTIVATING IN HIGH TECHNOLOGY FIELDS

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Abstract: *The importance of prognosis as a stage in strategic management process has to be emphasized, especially, in the context of preactive politics orientation which becomes more and more visible within actual development frame of organizations. In Romania, due to instability of business medium, the prediction process has a great deal of difficulty. The paper deals with some prognosis methods appropriate to organizations activating in high technology fields, but not only. Regarding the predictions of external general medium development, some very relevant results obtained with content analysis method are presented. Restraining the sphere of interest to high technology organizations, some aspects resulting from applying of relevance tree method (possibilities tree method) are also presented.*

Key words: *prognosis methods, relevance tree, content analysis, high technology fields.*

1. INTRODUCTION

The strategic prognosis process is absolutely necessary in actual context when preactive politics become more and more visible, emerging from American school, which gives great deal of importance to change management [1]. From this point of view, the establishing of *direction* and consequently, *concentration* – two of the fundamental principles of strategic management – are essential in order to efficiently use the resources of the organization. Peter Drucker said: "Concentration is the key of economic results", and in the context of prognosis process: "The next society has already irreversibly emerged". The management of an organization, commercial society, university or hospital must be based on *solid and predictable directions*, which must stand beyond newspaper titles. During instability time and unpredictable events (as in Romania), strategy and politics of an organization based on these steady and essential directions "*do not automatically lead to success, but otherwise guarantee failing*" [2].

Peter Drucker also forecasts that new major technologies are not apparent and going to emerge in the years to come. It is a great probability that these major technologies will have nothing to do with IT.

We can be sure that human society from 2030 will be very different that the present one, with no resemblance with actual (in vogue) predictions. It will not be dominated by IT, but this one will be one of the important technologies. The main characteristic of the "next society" will be determined by the new theories and institutions as it happened in case of previous recent revolutions – First (from the XVIIth century) and Second (from the XIXth century) Industrial Revolutions [2].

Although the prediction is indispensable as it is emphasized before, the strategic managers must face the *prediction paradoxes*:

- the future can be predicted only through extrapolation of the past; nevertheless the future will be extremely different than the past;
- although it is expected that predictions decrease the future insecurity, as the time horizon grows, the probability of unexpected emerging phenomena increases, which thus rising the uncertainty;
- although the prognoses could not be accurate, *no strategy is possible without prediction*.

The model of strategic prediction process comprises several stages. Between them, several interdependent relations operate as it is presented in Fig. 1. It must be highlighted that feed-back relations increase de precision and decrease uncertainty degree – the two main output parameters of prognosis process.

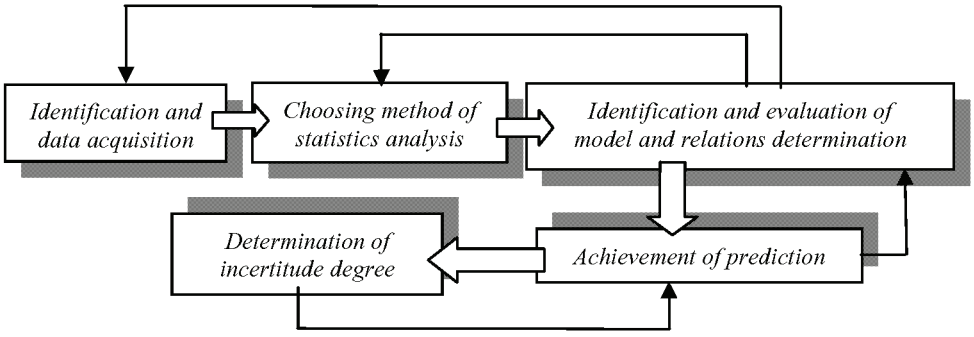

Fig. 1. Model of strategic prediction.

2. CASE STUDY OF PREDICTION IN IT FIELD

Lithography techniques used in the past for reproducing texts and art operas are today used for integrated circuits achievements.

In IT field a constant trend occurs to achieve transistors with reduced dimensions as low as possible and to assembly them on a surface as small as possible too.

Richard Phillips Feynman – american physicist and Nobel laureate – was the first who became aware of functional importance of this ultra miniaturizing: more transistors develop into smaller, more their working speed is greater and consume lower energy; more the surface containing them is smaller, more the time necessary to transmit electrical signals from a transistor to other decreases.

These factors lead to the relation between calculus speed and critical dimension:

$$\Delta v = 10^2 \cdot \Delta l^{-1}, \quad (1)$$

where: Δv is calculus speed increasing; Δl – dimensional lowering of the circuit – the line width of circuit.

Consequently, if critical dimension of circuit decreased 10 times, calculus speed increased 1000 times.

In 1964 Gordon Moore from Fairchild Semiconductor Corporation in the United States predicted that the number of transistors that could be implemented on a chip would increase two times every year. "Moore's law" prediction is not quite accurate, because the rate of increase is a doubling about every two to three years.

Current world state of the art in chips that are commercially available, such as the Intel Pentium, is a minimum feature size of about 300 nm with about 1.5 million transistors on a chip.

Specialized devices such as dynamic random access memory (DRAM) chips, which can store up to 64 million bits of information, have over 64 million transistors on them.

In the first decade of current century, the minimum feature sizes on commercial chips should decrease to between 100 and 200 nm for components such as DRAM chips that can store over 1 billion bits. Examples of these devices, which are included in the range of nanotechnology, have been demonstrated in the laboratory.

But the prediction of Moore is going to become more and more distant from actual reality. Three members of HP Labs' Quantum Science Research (QSR), group in Palo Alto offer a feasibility-level description and demonstration of the "*crossbar latch*" – a bistable-switch latch that promises to replace the traditional transistor [3]. A patent for the crossbar latch was granted in 2003 [4]. HP Lab researchers invented a device having a diameter of approximately 2 nanometers consisting of a single nanowire acting as a signal line, crossed by two control lines with an electrically switchable molecular-scale junction where they intersect. The three nanowires are separated by thin layers of stearic acid. By applying a sequence of voltage impulses to the control lines and using switches of opposite polarities, the latch can perform the NOT function essential for general computing operations. In addition, it can restore a logic level in a circuit to its ideal voltage value, allowing a designer to chain many simple gates together to perform an arbitrary computation.

Standard semiconductor circuits require three-terminal transistors to perform the 'NOT operation' and restore signals. However, it is generally believed transistors will not function at sizes of a few nanometers and that is why there is a practical limit to their miniaturization.

Thus, it could be possible to reinvent the computer at the molecular scale. The crossbar latch provides a key element needed for building a computer using nanometer-sized devices that are relatively inexpensive and easy to build. It was demonstrated that it could make a working memory with molecular-scale junctions and logic devices that could perform simple logic operations such as AND and OR. That means that Moore's Law may hold on for another 50 years with the potential for these processors that could be thousands of times more powerful than today.

3. CONTENT ANALYSIS METHOD

This method has the roots emerging during the WWII, when experts from information services searched a remote way to obtain data concerning actions of enemy states.

Under the leading of *Paul Lazarsfeld* and *Harold Lasswell*, who later would become well known theoreticians in communication science, the American administration took the decision to take on a content analysis of German papers. They did not provide accurate data about the country reserves, production, transport, food state, but they presented indirect information on these key areas. Through a careful analysis concerning isolated phenomena about events dedicated to closing or opening of factories, arriving, departure or postponing of the trains, lists of human losses and other local events, a correct imagine could be created regarding the evolution of phenomena presenting strategic interest.

The method is still in use by information services, which annually spend millions of dollars, undertaking content analysis of papers from different corners of the world.

Nevertheless, the first application of this method in strategic field prognosis, more precisely in social economic area was done barely in 1982, by John Naisbitt in his famous book, *Megatrends – Ten New Directions Transforming Our Lives*. The book was during 60 weeks in top of *best sellers* of the famous quotidian *New York Times*. This work was followed by an entire cycle of books focused on social economic prognosis as: *Reinventing the Corporation*. Transforming Your Job and Your Company for the New Information Society, Warner Books (1985); *Megatrends 2000*. Ten New Directions for the 1990´s. William & Morrow Company, Inc., (1990); *Global Paradox*. The Bigger the World Economy, the More Powerful Its Smallest Players. William Morrow & Company, Inc., (1994); *Megatrends Asia*. Eight Asian Megatrends That Are Reshaping Our World. Simon & Schuster, (1996); *High Tech/High Touch*. Technology and Our Accelerated Search for Meaning. Nicholas Braely Publishing, (2001).

The method is based on fact that space of news presentation is limited no matter mass media type is used (number of pages from a news paper, number of minutes allocated for television or radio news programs etc.). Therefore, when something new is introduced, something else must be eliminated – as an effect of principle of choice within a closed system. At individual or society level, if new preoccupations emerge, the old ones are forgotten. Following this development of priorities succession, process of change of social interests competing is evaluated.

Before publication of [5], during 12 years Naisbitt Group attended a huge number of publications (6000 local newspapers each month) considered as relevant concerning new trends from American society, being in point of a fundamental change of technological development. Even today, a trimestrial report regarding the trends at national and regional level is published and presented in seminaries with participation of interested companies (among them, *General Motors, General Electric, Meril Lynch, AT&T* etc.).

The results was the identification of *ten megatrends of evolution*, which proved to be real and actual even for Romania, due to the delay acting permanently during history, between advanced societies and less advanced ones.

The ten megatrends observed by Naisbitt in 1982 for American society are [5]:

1. **From industrial society to informational society:** We moved from an industrial society to one based on creation and distribution of information.

2. **From forced technology to high technology – high compensatory reactions:** We moved in two directions – high technology and high reactions, associating each new technology with a compensatory human response.

3. **From national economy to world economy:** We cannot afford the luxury to operate anymore within a national isolated autarchic system; we are part of a global economy.

4. **From short time perspective to long time perspective:** We reorganize society in which short time motivations are governing, in favour of a larger temporal approaching.

5. **From centralization to decentralization:** In organizations, capacity of acting in an innovative way is in progress, starting from the base to top.

6. **From the institutional help to self-help:** We moved from institutional help to own forces relying on.

7. **From representative democracy to participative democracy:** The representative system does work properly; restrained collective initiatives occur to which larger ones adhere.

8. **From hierarchies to networkings:** Ceasing of hierarchic structures in favour of nets assuring creative and innovative acting (chiefly important for businessmen).

9. **From North toward South:** more and more persons settle down in South and West.

10. **From exclusive option to multiple option:** From society based on "or" option (or boundary limited by individual choice) to nonconformist society, with multiple options.

4. RELEVANCE TREE METHOD

The method is used mainly in technological prognosis field, being also known on as „ *possibilities tree method*" and is based on decision tree theory, similar to „diagram tree" – used as quality improving method.

We improved the succession of method stages as it is presented below:

1) The *prognosis subject* is established, which is the object of method applying by an experts group. The subject is placed in the top of the tree (Fig. 2).

2) The moderator makes proposals to the group or the group himself proposes *successive levels of detailing* of the approached phenomenon (subject of prognosis) based on logical links between levels.

On each level, several evolution possibilities of studied phenomenon are determined. These evolution ways and detailing levels can be obtained applying *brainstorming* (creativity phase), which can also be considered a method of prognosis [6].

In practice, a tree with four levels and two main branches is constructed (Fig. 2).

3) *In analysis phase*, the moderator asks the group to verify if possible evolutions of predicted phenomenon correspond to each level of detailing and also, superposes the eventual same evolution states with different formulations on the same position within the tree. In case that the evolution states proposed by the group do not correspond to the required detail level, their position can be modified within the tree.

4) *Importance coefficients* on each level are established, for every possible evolution of phenomenon to be predicted, respecting the relation:

$$\sum_{j=1}^{m} c_{ij} = 1, \tag{2}$$

where: i is detailing level ($i = 0,\ldots, n$); j – number of possible evolution states on each level ($j = 1, \ldots, m$).

Practically, it was demonstrated that importance coefficients c_{ij} can be determined satisfactorily accurate through Delphi method.

5) *Relevance marks* (R_j) are calculated for each way (path) of evolution of phenomenon to predict, according to relation:

$$R_j = \prod_{i=0}^{n} c_{ij}. \tag{3}$$

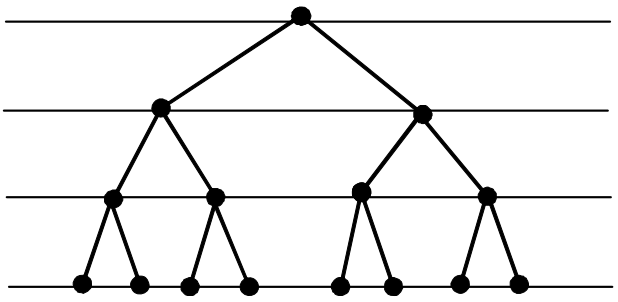

Fig. 2. Relevance tree – practical structure.

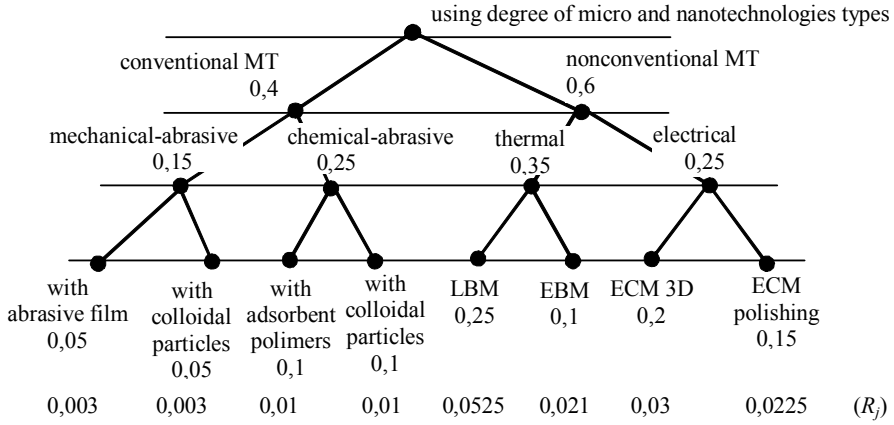

Fig. 3. Relevance tree applied for micro and nanotechnologies evolution.

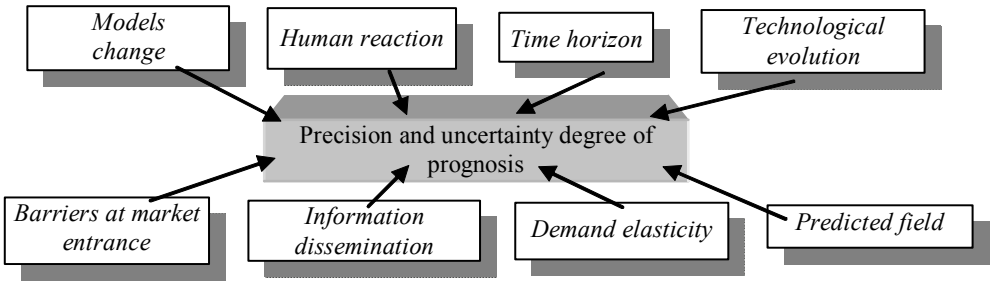

Fig. 4. Factors of influence of precision and uncertainty degree of strategic prognosis.

Fig. 3 presents the results obtained through relevance tree method in order to predict the degree of using of machining technologies (MT) types, in micro and nano field, in the following 5–10 years. The relevance tree method was applied by a group of experts activating in nonconventional technologies field.

5. DISCUSSION

Generally, the factors of influence on precision and uncertainty degree of prognosis are synthesized in Fig. 4. In case of high tech field, factors as models change, time horizon, technological evolution or even human reaction have greater weight as it is emphasized before. The major observations emerged from this paper, located on time scale from distant future to proximity one are:

1. According to Peter Drucker prognosis, the "next society" will not be dominated by information technology, but by new major theories and technologies which will have to emerge as it happened in case of previous industrial revolutions. So the absolutism of IT means as the only solutions to continue human technological evolution would be a mistake.

2. We perfected and applied the relevance three method for high tech organizations but also in educational system in order to forecast the most probable and efficient education form.

3. We also noticed the actuality for Romania – which has inevitable development delay – of John Naisbitt predictions achieved more than 20 years ago.

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