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EFFICIENCY OF KNOWLEDGE USE FOR ESTABLISHING IDEAS OF PERFORMANCE

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Abstract

The research and development field provides driving forces of economic growth. EU economy, including the national economies under the impact of scientific research and inventions results, turn into a multi-structural system. The intellectual development of the society is the most powerful productive force.

Keywords: *knowledge; information; argument; technologic; production.*

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Introduction

The last decades have marked awareness of the particular importance that information and knowledge have for social-economic development. More and more scientific personalities and specialists in the area of information emphasize their increased role in the modern age. Alvin Toffler argues that the third source of power that tends to become predominant in the future is information. At the same time, the Romanian scientists together with the authors plead and claim that information and communications are more and more a production force and the obtained information is a part of national wealth.

Methods

The problem addressed has a great theoretical significance. The analyzes, arguments, mathematical models, principles, goals, could all be the base of methodology for scientific researches in the field of creating the knowledge society, the scientific elaborations that shall become the Technological Revolution of the 21st Century.

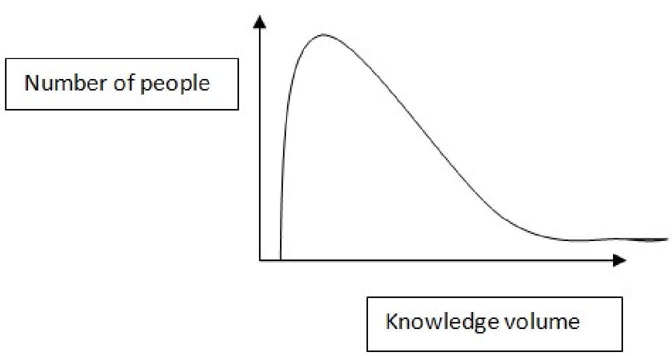

Fig. 1. Typical Situation of the Volume and Distribution of Knowledge in a System
Source: O. Niculescu, *Economics, Company and Management Based on Knowledge*, Economics Publishing, Bucharest, 2007

Results

Unfortunately, it is often found that the volume of essential information possessed by the members of an organization or country do not favour this process. From this point of view, the graphic from figure 1 above is self-evident, from which it results that only a small proportion of the components of a system possesses a great deal of knowledge and information, most of them possess a limited amount of knowledge. For these reasons, it is necessary to increase the maximum point and move the curve to the right, indicating an increase in the possession of knowledge as well as the increase of the number of people that are part of this category with a large amount of knowledge.

Comparing this distribution knowledge in a developed country and in a developing country we obtain the graph from figure 2 in which curve A reflects the situation in a developing country and curve B in a developed country.

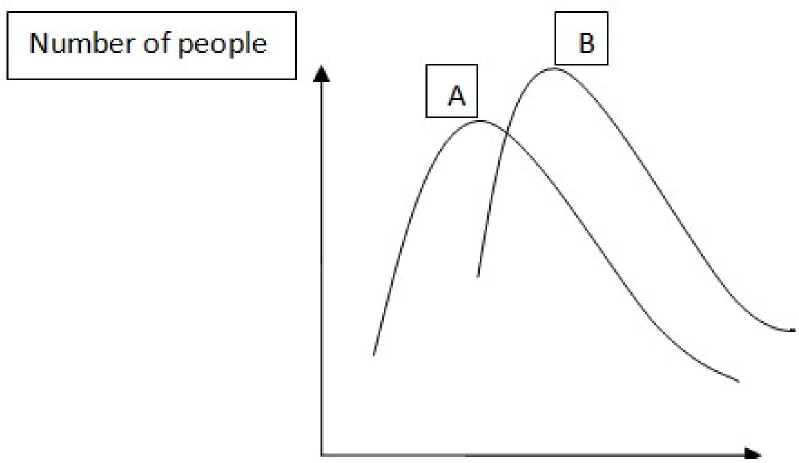

Fig. 2. Evolution and Distribution of Knowledge in two Countries with Different Development Levels

Source: O. Nicolescu, *Company and Management Based on Knowledge*, Economics Publishing, Bucharest, 2007

Intellect, according to the DEX (the Romanian Explicative Dictionary), is the ability to think, know, have rational activity, to operate with notions, mind,

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thinking, reason. What the intellect produces, namely ideas, are called intellectual products. Intelligence is the ability to understand easily, to grasp what is essential and to solve situations or problems based on past experience. Artificial intelligence is the ability of advanced technical systems to achieve quasi human performance. In this context, the products created by the intellect, intelligence (ideas, knowledge, innovation etc.) represents "intellectual products" or "smart products".

Knowledge is needed to generate ideas. Knowledge, however wide would be, is ineffective. Only knowledge-based products under certain conditions could have economic, ecological, social, military, political impact. A statement such as "the efficiency of knowledge" in our view is questionable.

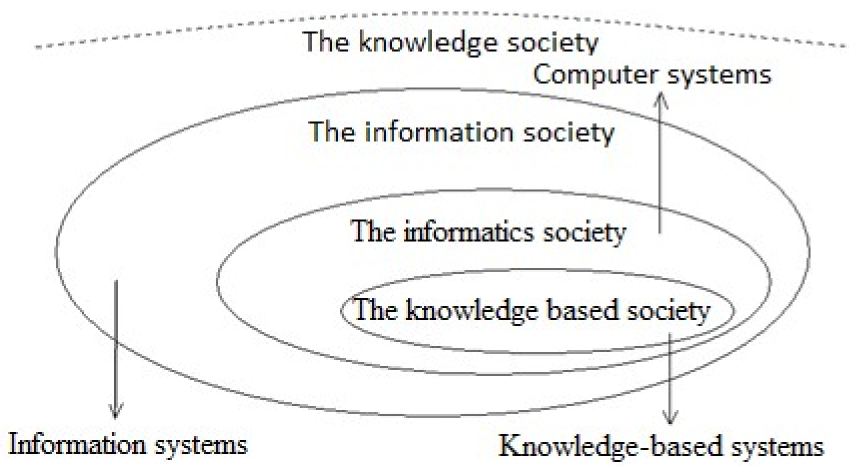

Fig. 3. The Concept of Knowledge Society

At present, any country that does not progress in the research and development sector is economically and socially regressing. In order to advance in the scientific field to the level of EU member states, candidate countries have to make considerable efforts by developing and applying future sciences. It is necessary to motivate innovative activities, to involve private capital in the research and development field. We consider the need to stimulate mutual cooperation between companies of the candidate countries to the EU, and companies from highly developed industrial countries in order to achieve the import "of ideas" and state-of-

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the-art technologies. It is useful to organize the application of innovations in all areas of human activities.

At present, in the European Union, all the development activities for knowledge and use of it are coordinated by programs (plans).

The research and development field provides driving forces of economic growth. EU economy, including the national economies under the impact of scientific research and inventions results, turns into a multi-structural system. The intellectual development of the society is the most powerful productive force.

The knowledge society is possible only graved onto the information and cannot be separated from it. At the same time, it is more than the information society through its major role that comes to information – knowledge in society.

In the past, a country could have become developed if it had natural wealth, geographical location and favourable climatic conditions. Currently, a country shall become rich only if it is “rich in ideas”. The list of key factors that could contribute to development, in our view, includes the following:

1. Low levels of uncertainty of possible options for fundamental scientific research, applied research, innovations, and their use in the creation of new technologies (X_1).

2. Sufficiently large number of industrial companies generating innovative technologies in production, non-production spheres, service providers (X_2).

3. Significant share of financing of research and development in GDP (X_3).

4. Increased number of scientific researches, innovators at 10,000 inhabitants (X_4).

5. Effective use of information technologies in all country activities (X_5).

6. Large number of scientific products produced in the country, imported in the country (X_6).

7. High level of education, in general (X_7).

8. Developed infrastructure for scientific research, innovation, design and implementation of their results (X_8).

9. Higher technological level in the country in territorial, branch, micro and macro level (X_9).

10. Demand/request from the economic subjects in the country regarding innovation, ideas in the field of research and development (X_{10}).

11. Sufficiently large number of well-prepared specialists (critical number), generators of ideas, inventions in the research and development field (X_{11}).

12. High level of technological development of economic activities in the country, percentage of primitive technologies based on the use of cheap manual labour in the country (X_{12}).

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13. Effective training technologies, high teaching quality of school textbooks (X_{13}).

14. Significant expanded level of scientific, educational, innovative, internship cooperation with countries that are developed in research-development field (X_{14}).

15. High level of motivation for work, including remuneration of the results achieved by the authors in the field of research and development (X_{15}).

16. Effective organization of research and development activities in the area by the government, by the managers of academic system, inclusively by using the methods "program-purpose" (X_{16}).

17. Level of labour remuneration in the country below the level of labour remuneration in the research and development field, in territorial, branch, micro profile (cheap labour – does not create innovative needs) (X_{17}).

18. Number and seriousness of the problems faced by society in all human activities, including economics, ecology, social, medical, institutional area etc. (X_{18}).

19. Effective ways to accumulate scientific ideas, innovative in the country and inclusively abroad (X_{19}).

20. Effective ways of organizing continuous education in all human activities (X_{20}).

21. High level of remuneration for authors' work for publication of ideas, innovations in research and development area (excluding cases when authors are obliged to bear the costs for publishing their works) (X_{21}).

The elements mentioned above represent the minimum necessary conditions to achieve success in the field of research and development, the creation of nanotechnologies in order to endure the competitive economic and social growth of the EU countries.

Economic growth (GDP) could be correlated with the listed factors by formulating a production function, which can be written as follows:

$$Y = F(x_1, x_2, ..., x_{21}) \quad \textbf{(1)}$$

where $x_i \geq 0$, $i = 1, 2, ..., 21$

A particular case of function [1] is function Cobb-Douglas:

$$Y = A\, x_1^{\alpha_1} x_2^{\alpha_2} \ldots x_{21}^{\alpha_{21}} \quad \textbf{(2)}$$

where A = proportionality coefficient; $x_{1........}x_{21}$ = the 21 perturbation factors of social economic development; parameters α_i, where i = 1…..21 – quantifying the elasticity of respective factor.

To simplify the stated aspects, function [2] is expressed in natural algorithms:

$$\ln Y = \ln A + \sum_{i=1}^{21} \alpha_i \ln x_i \qquad \textbf{(3)}$$

By derivation of the equation [3] with respect to x_i, i = 1, 2, ..., 21 we obtain the following:

$$\frac{1}{Y}\frac{\partial Y}{\partial x_i} = \frac{\alpha_i}{x_i}, \qquad i = 1, 2, ..., 21 \qquad \textbf{(4)}$$

Which also could be written as:

$$x_i \frac{\partial Y}{\partial x_i} = \alpha_i Y \quad , \qquad i = 1, 2, ..., 21 \qquad \textbf{(5)}$$

By summing the equations [5], we obtained the following relation

$$\sum_{i=1}^{21} x_i \frac{\partial Y}{\partial x_i} = Y\left(\sum_{i=1}^{21} \alpha_i\right) \qquad \textbf{(6)}$$

From [6] equation it results that GDP (Y) of the country (exemplified for Romania and the Republic of Moldova) could be multiplied by $\left(\sum_{i=1}^{21} \alpha_i\right)$ or what represents the elasticity of GDP in relation to the variables x_i , i = 1, 2, ..., 21. At the same time the amount may be:

$$\sum_{i=1}^{21} \alpha_i = \begin{cases} >1, \textbf{ the factors have a rising productivity;} \\ =1, \textbf{ the factors have a constant productivity;} \\ <1, \textbf{ the factors have a decreasing productivity.} \end{cases} \qquad \textbf{(7)}$$

The form of production function (1) is of principal importance. The production function should not only give us data about the country's GDP evolution under the impact of stated factors, but it is appropriate to describe evolutionary processes.

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Function (1) must possess the following properties: be continuous, be non-negative for any positive values of the variable x_i , i = 1, 2, ..., 21; have unique values, well-determined, under restriction; convert to zero if one or more of the factors x_i , i = 1, 2, .., 21 are equal to zero; be differentiable; reducing the impact of a factor can be complimented by the effort of another factor among the 21 factors; the elasticity of GDP is determined by the efficiency of each factor; the values of the 21 factors determine the extreme GDP; mathematical transformations could be interpreted economically. Function (1) linear, parabolic, hyperbolic type, Coob-Douglas, Mitcherlih-Baul, Spliman, Balmucand, Lomax type do not satisfy the above listed conditions (properties). To deduce the form of function (1), the examination of GDP evolution is reduced for the case when it depends on a single factor – x_1.

It is admitted that function (1) has the form $Y = F(x_1)$, GDP depends only on the x_1 factor. We note by b_1 – the increase of the GDP logarithm to a unit of logarithm increase of factor x_1; $b_1 \ln x_1$ – GDB logarithm increase to $\ln x_1$ growth units of factor x_1; $\gamma_1 x_1$ – increase of x_1 factor, γ_1 – proportionality coefficient.

$\frac{b_1 \ln x_1}{\gamma_1 x_1}$ – increase of GDP logarithm to a growth unit factor x_1. Therefore,

$\ln Y = \frac{b_1 \ln x_1}{\gamma_1 x_1 \ln e} = \frac{\ln x_1^{b_1}}{\ln e^{\gamma_1 x_1}}$ or $Y = \frac{x_1^{b_1}}{e^{\gamma_1 x_1}}$. Similarly, could also be interpreted the contribution of factors i = 2, 3, ..., 21 to the increase of GDP. Function (1) will take the form:

$$Y = A\frac{x_1^{b_1}}{e^{\gamma_1 x_1}} \cdot \frac{x_2^{b_2}}{e^{\gamma_2 x_2}} \cdot \ldots \cdot \frac{x_{21}^{b_{21}}}{e^{\gamma_{21} x_{21}}} = A\frac{\prod_{i=1}^{21} x_i^{b_i}}{\prod_{i=1}^{21} e^{\gamma_i x_i}} = A\prod_{i=1}^{21}\frac{x_i^{b_i}}{e^{\gamma_i x_i}} \qquad \textbf{(8)}$$

In this interpretation, the element $e^{\gamma_i x_i}$ plays the role of mathematical norm, each factor i, i = 1, 2, ..., 21 being normalized. The elasticity of GDP in relation to the variable x_i, i = 1, 2, ..., 21 is:

$$E_{x_i}(Y) = \frac{\partial Y}{\partial x_i} \cdot \frac{X_i}{Y} = b_i - \gamma_i x_i, \qquad i=1,2,\ldots,21 \qquad \textbf{(9)}$$

Determining the GDP elasticity to a growth unit factor i, i =1, 2, ..., 21 is: $\frac{\partial E_{xi}(Y)}{\partial x_i} = -\gamma_i$ i=1,2,...,21

This result could be interpreted: GDP under the impact of the knowledge factor x_1 increases but these (GDP growth) are decreasing.

Function (8) is an extremum (maximum), obtained from the system:

$$\begin{cases} \frac{\partial Y}{\partial x_1} = \left(\prod_{i=1}^{21} \frac{x_i^{b_i}}{e^{\gamma_i x_i}} \right)'_{x_1} = A \prod_{i=2}^{21} \frac{x_i^{b_i}}{e^{-\gamma_i x_i}} \cdot x_1^{b_1 - 1} e^{-\gamma_1 x_1} \cdot \gamma_1 \left(\frac{b_1}{\gamma_1} - x_1 \right) = 0 \\ \frac{\partial Y}{\partial x_2} = \left(\prod_{i=1}^{21} \frac{x_i^{b_i}}{e^{\gamma_i x_i}} \right)'_{x_2} = A \prod_{\substack{i=1 \\ i \neq 2}}^{21} \frac{x_i^{b_i}}{e^{-\gamma_i x_i}} \cdot x_2^{b_2 - 1} e^{-\gamma_2 x_2} \cdot \gamma_2 \left(\frac{b_2}{\gamma_2} - x_2 \right) = 0 \\ \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \\ \frac{\partial Y}{\partial x_{21}} = \left(\prod_{i=1}^{21} \frac{x_i^{b_i}}{e^{\gamma_i x_i}} \right)'_{x_{21}} = A \prod_{i=1}^{20} \frac{x_i^{b_i}}{e^{-\gamma_i x_i}} \cdot x_{21}^{b_{21} - 1} e^{-\gamma_{21} x_{21}} \cdot \gamma_{21} \left(\frac{b_{21}}{\gamma_{21}} - x_{21} \right) = 0 \end{cases} \quad \mathbf{(10)}$$

It is determined $x_i = \frac{b_i}{\gamma_i}$ - I value factor, i = 1, 2, ..., 21 for which GDP shall have extremum.

Whereas $\frac{\partial^2 Y}{\partial x_i^2} > 0$, then for $x_i = \frac{b_i}{\gamma_i}$ $\rightarrow$ GDP shall be maximum.

For X< $\frac{b_i}{\gamma_i}$ GDP growth shall be positive, $\frac{\partial Y}{\partial x_i} > 0$.

For X> $\frac{b_i}{\gamma_i}$, GDP shall decrease.

Further on, the parameters β_i, γ_i are determined. In some cases, these parameters can be determined by using the minimum squares method and in others – the method of analyzing expert data is used.

It results that each scientific area, research direction can be quantified by various criteria. These criteria may also constitute an incompatible system. Economic criteria and fundamental science criteria most of the time generate a present negative profit, but in perspective could create considerable profits. Under these circumstances, the selection of directions could only be performed by experts in different areas.

For every area, the direction of scientific research d_i (i = 1, 2, ..., m) is estimated considering the criteria α_j (j = 1, 2, ..., n).

Area d_i, by criteria α_j are assigned by experts' d_{ij} points. j criteria are also estimated, (j = 1, 2, ..., n) to which they correspond α_j points (percentages in relation to the total).

$$\sum_{j=1}^{n} \alpha_j = 1 \quad \alpha_j \geq 0, \; j=1,2,...,n \qquad \textbf{(11)}$$

Therefore, $\sum_{j=1}^{n} \alpha_j d_{ij}$ represents the estimation of i domain by the percentage of criteria, i = 1, 2, ..., m. In other words, domains $d_1, d_2, ..., d_i, ..., d_m$ are estimated by the product:

$$\begin{pmatrix} d_{11} & d_{12} & \dots & d_{1j} & \dots & d_{1n} \\ d_{21} & d_{22} & \dots & d_{2j} & \dots & d_{2n} \\ - & - & - & - & - & - \\ d_{i1} & d_{i2} & \dots & d_{ij} & \dots & d_{in} \\ - & - & - & - & - & - \\ d_{m1} & d_{m2} & \dots & d_{mj} & \dots & d_{mn} \end{pmatrix} \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_j \\ \vdots \\ \alpha_n \end{pmatrix} = \begin{pmatrix} \sum_{j=1}^{n} d_{1j}\alpha_j \\ \sum_{j=1}^{n} d_{2j}\alpha_j \\ \vdots \\ \sum_{j=1}^{n} d_{ij}\alpha_j \\ \vdots \\ \sum_{j=1}^{n} d_{mj}\alpha_j \end{pmatrix} \qquad \textbf{(12)}$$

The research direction (field) d_i, (i=1,2,...,m) is measured by the specialists in the field considering the estimated criteria (according to the level of importance, actuality, gravity etc.) in the respective fields of scientific research.

To the field (direction) d_i, i = 1, 2, ..., m are assigned $\sum_{j=1}^{n} d_{ij}\alpha_j$ points.

The directions or areas where research is needed cannot always be covered with scientific, innovative, experimental potential of EU countries. In these cases, some research areas shall be excluded from the scientific research nomenclature, introducing variables. The vector of areas, directions with national scientific coverage is determined by the product:

$$\left(d_1, d_2, \ldots, d_i, \ldots, d_m\right)\begin{pmatrix} \beta_1 & 0 & \cdots & 0 & \cdots & 0 \\ 0 & \beta_2 & \cdots & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \cdots & \beta_i & \cdots & 0 \\ \vdots & \vdots & & \vdots & & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & \beta_m \end{pmatrix} = \left(\beta_1 d_1, \beta_2 d_2, \ldots, \beta_i d_i, \ldots, \beta_m d_m\right) \quad \textbf{(13)}$$

where $\beta_{i\geq 0}$,

In which:

$$\beta_i = \begin{cases} 1, & \text{if i area is investigated in Romania} \quad , \text{i=1,2,...m} \\ 0, & \text{if i areas is investigated in EU} \quad , \text{i=1,2,...m} \end{cases}$$

We started from the scientific, innovative, creative potential, from the investigative processes infrastructure, with the variables divided/designed a D matrix consisting of elements $D = \left\{d_{ij}\right\}_{mxn}$ in matrices $D^{(R)}$ and $D^{(ue)}$, where $D^{(ue)}$ is the selective matrix of research for the scientific potential of EU countries and $D^{(R)}$ is set for researchers from another regional area:

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$$D^{(R)} = \begin{pmatrix} \beta_1 & 0 \dots & 0 \dots 0 \\ 0 & \beta_2 \dots & 0 \cdots 0 \\ \vdots & \vdots & \vdots \\ 0 & 0 \dots \beta_i & \dots 0 \\ \vdots & \vdots & \vdots \\ 0 & 0 \; 0 \; 0 & \cdots \beta_m \end{pmatrix} \begin{pmatrix} d_{11} & d_{12} \dots d_{1j} \dots d_{1n} \\ d_{21} & d_{22} \dots d_{2j} \dots d_{2n} \\ \dots & \dots \\ d_{i1} & d_{i2} \dots d_{ij} \dots d_{in} \\ \dots & \dots \\ d_{m1} & d_{m2} \dots d_{mj} \dots d_{mn} \end{pmatrix} = \begin{pmatrix} \beta_1 d_{11} & \beta_1 d_{12} \cdots \beta_1 d_{1j} & \cdots & \beta_1 d_{1n} \\ \beta_2 d_{21} & \beta_2 d_{22} \cdots \beta_2 d_{2j} & \cdots & \beta_2 d_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \beta_i d_{i1} & \beta_i d_{i2} \cdots \beta_i d_{ij} & \cdots & \beta_i d_{in} \\ \vdots & \vdots & \vdots & \vdots \\ \beta_m d_{m1} & \beta_m d_{m2} \cdots \beta_m d_{mj} & \cdots & \beta_m d_{mn} \end{pmatrix} \quad (14)$$

$$D^{(UE)} = \begin{pmatrix} (1-\beta_1) & 0 & \dots & 0 \dots 0 \\ 0 & (1-\beta_2) & \dots & 0 \dots 0 \\ \dots & \dots & \dots & \dots \\ 0 & 0 \dots (1-\beta_i) & & 0 \\ \dots & \dots & \dots & \dots \\ 0 & 0 \dots & 0 \dots & (1-\beta_m) \end{pmatrix} \begin{pmatrix} d_{11} & d_{12} \dots d_{1j} \dots d_{1n} \\ d_{21} & d_{22} \dots d_{2j} \dots d_{2n} \\ \dots & \dots \\ d_{i1} & d_{i2} \dots d_{ij} \dots d_{in} \\ \dots & \dots \\ d_{m1} & d_{m2} \dots d_{mj} \dots d_{mn} \end{pmatrix} \quad (15)$$

The main directions, research and development areas (i) are: communicative information systems; science about life; sustainable economic development; nano-systems industry; transport systems; energy systems. The knowledge of society turns into means of producing the ideas of solving the problem: as well is for the future to be built; we start from available knowledge; how the knowledge of society has developed in order to succeed in building the future. In the processes of studying the future, we need to consider the following three problems: be predicted, be aware of, be solved.

The above calculation elements are significant for examining/evaluating advance investments towards the knowledge based on society.

Basic, applicative, innovative science could contribute to the upgrading of traditional technologies, but could also create new core technologies, called nanotechnologies.

The conclusions to be drawn are the following:

▪ The minimum level of knowledge in a developed country is significantly higher than in a country in development.

▪ The maximum level of knowledge possessed by the most informed people in countries in development is clearly lower than the people and their number in developed countries.

▪ The number of informed people at a high level in developed countries is significantly higher than that of its counterparts in countries in development.

▪ The volume of knowledge and information is bigger and higher in a developed country than in a country in development.

Therefore, for the conclusion to be that developing countries reach informationally developed countries, curves A and B must be identified or at least close to the four plans considered. The resulting solution is that of performance of a massive transfer of knowledge and knowledge management through all possible paths: macro, meso and micro-social.

The magnitude and speed of management knowledge transfer is conditioned by the following factors: the size of the companies, the openness of the society, the people's freedom of movement between countries, the control and regression of people at macro and micro-social level, the degree of knowing foreign languages by a country's population, and especially its level of preparedness.

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