ROMANIA'S R&D AND INNOVATION POTENTIAL AT EU LEVEL AND THE MANAGERIAL IMPLICATIONS FOR SMEs

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ABSTRACT
This paper aims to assess Romania's R&D and innovation potential within the European context, and to identify the main managerial implications for SMEs that result from the analysis. In order to do so, we have compared the trends emphasized by the classical assessment of R&D and innovation and those underlined by the changes in the volume of productive knowledge that is implied in the export structure – i.e. the economic complexity index. As a result, we managed to identify a strong positive correlation between the growth rates of the GDP per capita and the economic complexity index during 1995 – 2012, as well as the fact that there are two main groups of states whose economic complexity has grown: the Baltic and the Central European countries. Therefore, it can be argued that there are some forces that make the medium and long term perspective of Romania, in terms of R&D and innovation, look much better than the simple extrapolation of the latest trends regarding the R&D personnel and gross expenditures.
Although the amount of the societal know-how is critical for R&D and innovation, making it easier to start entrepreneurial activities with high degree of novelty and innovation, the accumulation and retention of knowledge is a quite costly encounter for SMEs. As a consequence, there are some major managerial implications for SMEs that result from the analysis of the Romania's R&D and innovation potential.

KEYWORDS: *Knowledge-based economy, European Union, R&D, SMEs*

JEL CLASSIFICATION: *L29, O11, O30, O52*

1. INTRODUCTION

As we are facing the transition to the knowledge-based economy, the role of R&D and innovation is constantly increasing. Because the challenges we are facing have a systemic nature, the instability, turbulence and uncertainty are increasing to such a high degree, that the "old solutions" are no more effective and acceptable, but the "new approaches" a yet to be found. A working definition emphasizes that the *"knowledge-based economy is characterized by the transformation of knowledge in raw material, capital, products, essential production factor for the economy, and by economic processes in which the generation, selling, acquisition, learning, stocking, developing, splitting and protection of the knowledge become predominant and decisive for long term profit gaining and sustainability assurance"* (Nicolescu, 2011).
When assessing the R&D potential of a country, there are a lot of elements to be taken into account, from historical and geographical context, to specific public policies (regarding human resources, taxation, industrial development etc.) that are put in place at a certain moment. If we approach this subject in the framework of the EU constraints and incentives, we could argue that the R&D potential relies heavily on the following pillars: (1) the intensity of entrepreneurial activity, (2) the ability/capacity to raise funds for projects, (3) the availability of appropriate research personnel and

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(4) the competitiveness of the R&D national system (incentives). It is important to mention that these four elements are neither static, nor isolated, therefore interacting with each other and possessing a certain dynamic. This way of analyzing the R&D potential focuses more on the inputs - i.e. the elements participating directly to the research, development and innovation processes, but it proves to be very useful the approach of looking at the potential from the perspective of the output structure and its dynamic. The second approach is complementary to the first, and gives us the tools for identifying a more complex spectrum of insights regarding R&D and innovation potential. Therefore, the size of the societal know-how of doing complex products in a competitive way (measured by the economic complexity index) is critical for R&D and innovation because the diversity of human capabilities that are involved in producing various and complex products are more likely to get involved in entrepreneurial activities with high degree of novelty and innovation, also being able to create competitive teams and take calculated risks.

2. THEORETICAL FRAMEWORK

The theoretical literature that deals with the issue of R&D and innovation underlines the critical role of collaboration between organizations for the success of a project (Kesavayuth, 2012). There are also authors that empirically demonstrate the positive correlation between the volume of resources allocated to a specific R&D project and its success rate (Schwartz, 2012). In a way, the need for acquiring critical mass has generated an intense debate whether the public R&D subsidies crowd out private R&D investments. Regarding this second issue, although counterintuitive, there is empirical evidence that the *"funded firms are significantly more R&D active than non-funded firms"* (Aerts, 2008).
Other authors have focused on researching the impact of management and corporate governance on the propensity to conduct research and development activities. Their research emphasizes that in order to *"enhance companies' innovation and R&D capabilities, need to improve their corporate governance"* (Dong, 2010), therefore presenting a set of very interesting findings (Lin, 2011): *"(1) the presence of CEO incentive schemes increases both corporate innovation effort and innovation performance; (2) sales-based performance measure in the incentive scheme, as compared with profit-based performance measure, is more conducive to firm innovation; and (3) CEO education level, professional background and political connection are positively associated with firm's innovation efforts".* A more theoretical approach regarding R&D management underlines that *"the perspective on managing R&D processes has changed over the years, moving from a technology-centered model to a more interaction-focused view"* (Nobelius, 2004). In this context, there are also authors that took the courage to actually make some proposals regarding the need for growing the R&D capabilities, like (a) improving the in SMEs and quality of corporate management; and (a) incentivizing the collaborative and cooperative behavior of organizations (Martinez-Roman, 2011).
A more holistic approach regarding the acquisition and retention of the societal know-how resulted in developing specific tools for measuring the volume of productive knowledge that is implied in the export structure – i.e. the economic complexity index (Hausmann et al, 2011).
It is also important that we review some of our previous works in order to put in context the present paper. In a recent study (Lavric, 2012), we have identified three main clusters of states at European level that possess different characteristics regarding research and development: (1) states with low R&D intensity (Hungary, Lithuania, Poland, Malta, Slovakia, Bulgaria, Latvia, Cyprus and Romania), (2) medium R&D level (France, Slovenia, Belgium, Netherlands, Ireland, Great Britain, Estonia, Portugal, Czech Republic, Spain and Italy) and (3) countries with high R&D level (Finland, Sweden, Denmark, Germany and Austria). The polarization among EU states is also emphasized by the fact that the retribution per employee increases more rapid than the economic development level, thus suggesting that the intensity and comparative advantage of the incentives given to the researchers is generating an imbalance at EU level that transposes into a brain drain effect (Lavric, 2013).

3. METHODOLOGY

In this paper, in order to draft the general framework, we made a meta-analysis of the research results regarding the level of economic development in the European Union and the amount of gross R&D expenses as percentage of GDP and the dynamics of R&D human resources in Romania and in EU. Also, in order to better assess the R&D and innovation potential, we enriched the analysis by correlating the data collected by Eurostat with the data collected at the Center for International Development, Harvard University – The Atlas of Economic Complexity initiative. The leading indicator we used is the economic complexity index that shows *"how diversified and complex a country's export basket is"*. In order to make our research consistent with the prior studies, we processed the available data from 1995 to 2012 for the following EU states: Finland (FI), Sweden (SE), Denmark (DK), Germany (DE), Austria (AT), France (FR), Slovenia (SI), Belgium (BE), Netherlands (NL), Ireland (IE), United Kingdom (UK), Estonia (EE), Portugal (PT), Czech Republic (CZ), Spain (ES), Italy (IT), Hungary (HU), Lithuania (LT), Poland (PL), Slovakia (SK), Bulgaria (BG), Latvia (LV), Romania (RO) and Greece (EL).
In our paper we have tested the correlation between the growth rates of the GDP per capita and the economic complexity index during 1995 – 2012, as well as the evolution of Romania's economic complexity index in the last 17 years. As a result, in the end of the article we were able to identify a set of managerial challenges for SMEs that derive from the current context regarding R&D and innovation potential.

4. RESULTS

4.1. R&D and innovation potential in the European Union

As shown in our prior research (Lavric, 2012), there is a positive correlation between the size of R&D expenses as percentage of GDP (GERD) and the level of economic development (GDP per capita). At EU level we have identified three main clusters of states that possess different characteristics regarding research and development (Figure 1): (1) states with low R&D intensity (Hungary, Lithuania, Poland, Malta, Slovakia, Bulgaria, Latvia, Cyprus and Romania), (2) medium R&D level (France, Slovenia, Belgium, Netherlands, Ireland, Great Britain, Estonia, Portugal, Czech Republic, Spain and Italy) and (3) countries with high R&D level (Finland, Sweden, Denmark, Germany and Austria). We can easily observe the fact that the eastern frontier of the EU is almost exclusively comprised of states with low R&D intensity, with the following specific traits: a GERD ranging between 0,47% and 1,16% and a GDP per capita of 4.800 – 14.700 euro. The list of states with medium R&D level is comprised of entities with Latin and Anglo-Saxon origin, scoring between 14.200 and 35.400 euro per capita in terms of GDP, and 1,26% – 2,26% as regard to the volume of gross R&D expenses as percentage of GDP. The leaders in R&D and innovation at the EU – Finland, Sweden, Denmark, Germany and Austria – are states with Germanic origin and influence, with a GDP per capita of 30.300 – 42.500 euro and a GERD ranging from 2,76% to 3,87%. It is quite clear that the cultural, geographical and historical background play a great role alongside the institutional structure that is put in place to foster R&D and innovation.
The R&D and innovation potential of Romania does not look too promising in the EU context, as we have already shown, Romania is at the bottom of the ranking regarding R&D intensity. Another way of investigating the issue of potential is to see the long term trends in the field of R&D personnel, as this is one of the most critical resources – it takes a lot of time and resources to train them and it is very difficult, if not impossible, limit its mobility. We have argued in a recent study of ours that in the European Union the share of R&D human resources in the total number of employees is positively correlated with the level of economic development (Lavric, 2013). What is

important about this finding is that Romania's dynamic is divergent, as the proportion of R&D personnel in the total has decreased by 0,13 p.p. (-17,33%) from 0,75% in 2003 to 0,62% in 2010. In other words, Romania is departing from the EU average both in terms of R&D and innovation potential and potential growth, thus opposing the objective need for real and nominal convergence. There is also another important aspect regarding the R&D human resources that consists in the fact that the retribution per employee increases more rapid than the economic development level, thus suggesting that the intensity and comparative advantage of the incentives given to the researchers is generating an imbalance at EU level that transposes into a brain drain effect. By taking into account the above mentioned elements, Romania's R&D and innovation potential is under great pressure to shrink, therefore posing a challenge in terms of real and nominal convergence.

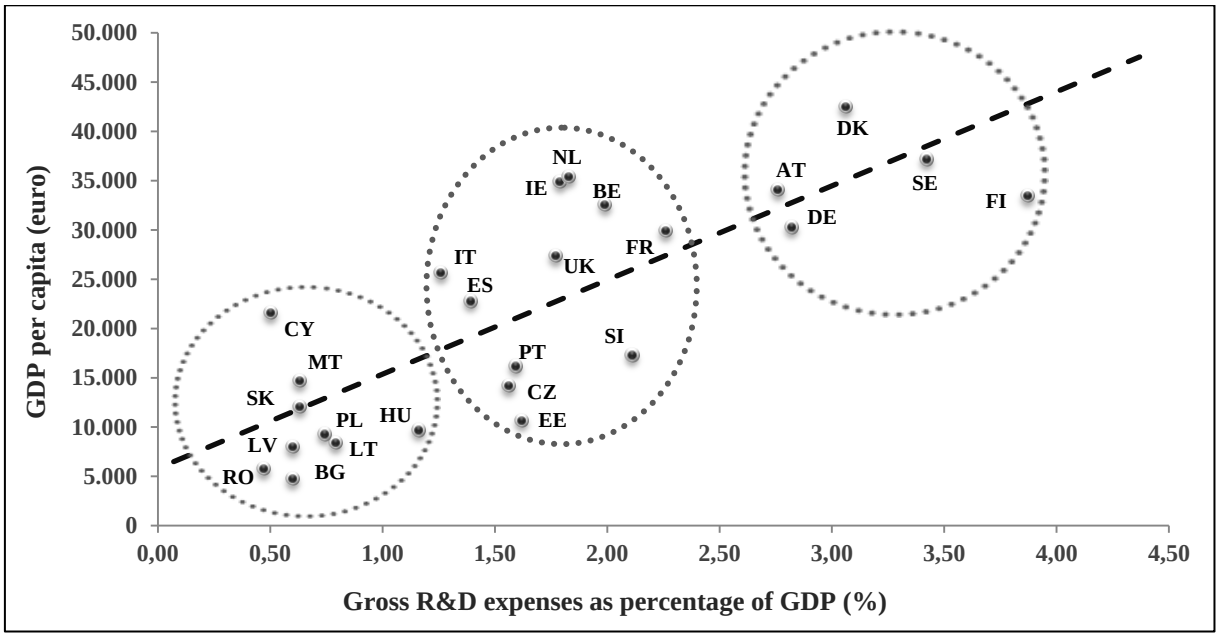

Figure 1. GDP per capita and GERD correlation in the European Union
Source: Lavric V. (2012)

4.2. Economic complexity as a proxy for R&D and innovation potential

The economic complexity index (Hausmann, 2011) is one of the tools by which we can measure the volume of productive knowledge that is implied in the export structure – the most competitive segment in an economy. The amount of the societal know-how of doing complex products in a competitive way is a determinant for the R&D and innovation potential because the mix of human capabilities that are involved in producing various and complex products are more likely to get involved in entrepreneurial activities with high degree of novelty and innovation, also being able to create competitive teams that possess a diverse set of skills, abilities and know-how. It is also important to point out that, most of the time, the R&D and innovation is integrated structurally in a value chain, thus being critical to have the needed inputs, suppliers and customers, and therefore, a proper business ecosystem is a critical factor in terms of survival and success.
As we have arrived to a partial conclusion, it is interesting to see if the amount of the societal know-how of doing complex products in a competitive way (economic complexity index) is suggesting the same findings. In nominal terms, in 2012 the average economic complexity index was 1.28 for the group with high R&D intensity, 1.12 for the states with medium level and 0.82 in the case of those with low R&D development (Figure 2). Although the averages maintain the correlation, we see that there is a large variability among the states. If we are to make a ranking, Romania is the

19th out of 24, with a level of 0,81 – i.e. 1,85 times lower than UK (1,50; 1st place) and 3,4 times higher than Greece (0,24; 24th).

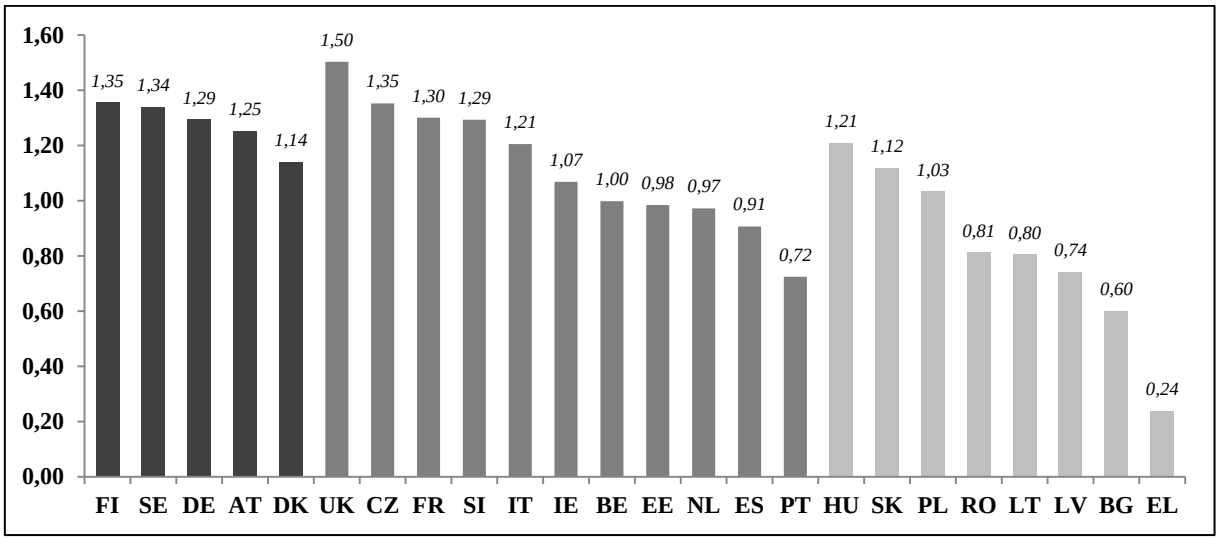

Figure 2. Economic complexity index in the European Union
Source: "The Atlas of Economic Complexity" data, own calculations

A fist glimpse of a certain dynamic that is counterintuitive and suggests the existence of certain processes that foster the convergence in the European Union derives from Figure 3 – the change in percentages of the economic complexity index in 2012 as compared to 1995. As we see, almost all the countries with low R&D intensity (excepting Slovakia) had a consistent increase, ranging from 8,3% to 113,0%, while all the states that are with medium (excepting Estonia and Portugal) and high R&D level registered decreases between -6,5% and -30,3%. This type of evolution emphasizes the fact that the economic forces are putting pressure to attenuate the differences among countries. The transformation in the field of the societal know-how of doing complex products and services in a competitive way has structural implications for an economy; therefore, the raising complexity and diversification are critical premises for development – as they influence directly the growth potential.

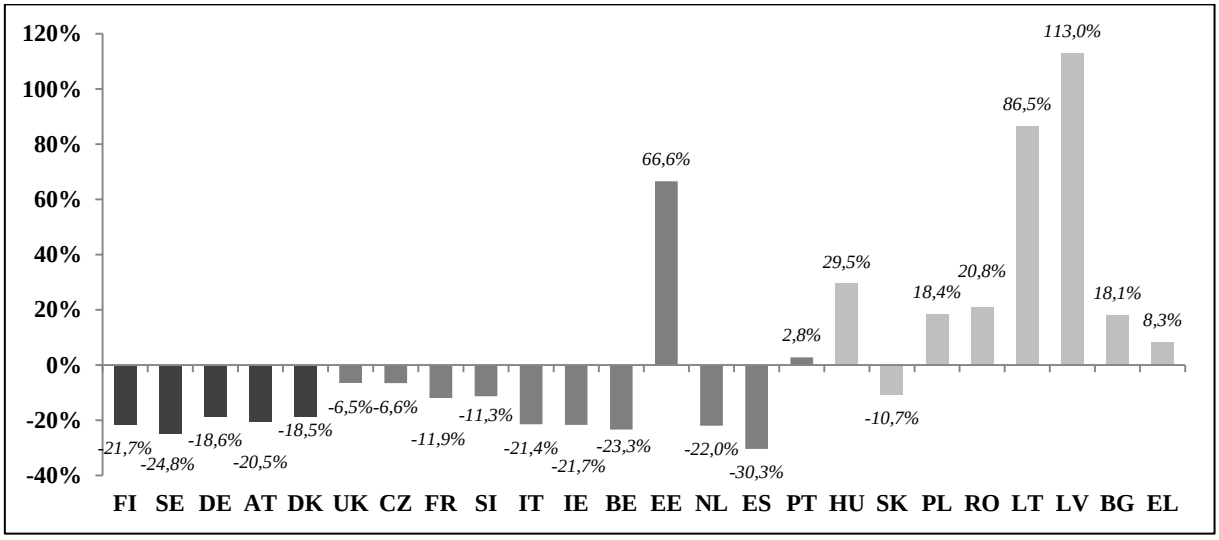

Figure 3. Economic complexity index dynamics in 1995 – 2012
Source: "The Atlas of Economic Complexity" data, own calculations

The evolution of Romania during 1995 and 2012 in terms of economic complexity underlines the fact that there are five main fazes: (1) from 1995 to 2000 the complexity decreased by 2,33 times, from 0,67 to 0,30; (2) from 2000 to 2002 – a quasi-stagnation; (3) from 2002 – 2008 the index increased by 2,55 times, up to 0,79; (4) from 2008 to 2010 – a decrease by 23%, followed by a rebound in the 2010 – 2012 period. This dynamic is very instructive and shows a consistent transformation of the Romanian economy. Actually, it pictures the transition from an artificially sustained "portfolio" of products and services Romania produced in the state-owned companies, to a mainly private competitive structure of producing complex and diverse products. In this sense, we could argue that there are some forces that make the medium and long term perspective of Romania, in terms of R&D and innovation, look much better than the simple extrapolation of the latest trends resulted from the analysis of the R&D human resources and gross expenditures. The accumulation of societal know-how makes it easier for new ventures to arise and for new ideas to be put in place.

As we continue to investigate the issue of R&D and innovation potential from the perspective of economic complexity, a strong positive correlation arises between the growth rates of the GDP per capita (purchasing power standard) and the economic complexity index during 1995 – 2012 interval (Figure 4). Although the R^2 is not as high as a linear regression will require for a very precise estimation of future values, it is important to acknowledge that the correlation is strong. As we see in the figure, for every 1% increase in the economic complexity index, it is expected that the GDP per capita at purchasing power standard will increase by 0,8%. Another element that results from our analysis is that there are two main groups of states whose economic complexity has grown: (1) the Baltic states (Latvia, Lithuania and Estonia) and (2) the Central European countries (Poland, Romania, Hungary and Bulgaria). Although the difference is in the magnitude of the change, all these countries are on the eastern frontier of the European Union, thus suggesting that the caching-up processes are functioning in a sensible manner. This shift in the positioning of the capabilities in Europe, suggests that the R&D and innovation activities will follow the manufacturing, thus reversing the divergent pressures that are exercised by current imbalances in the R&D incentive systems.

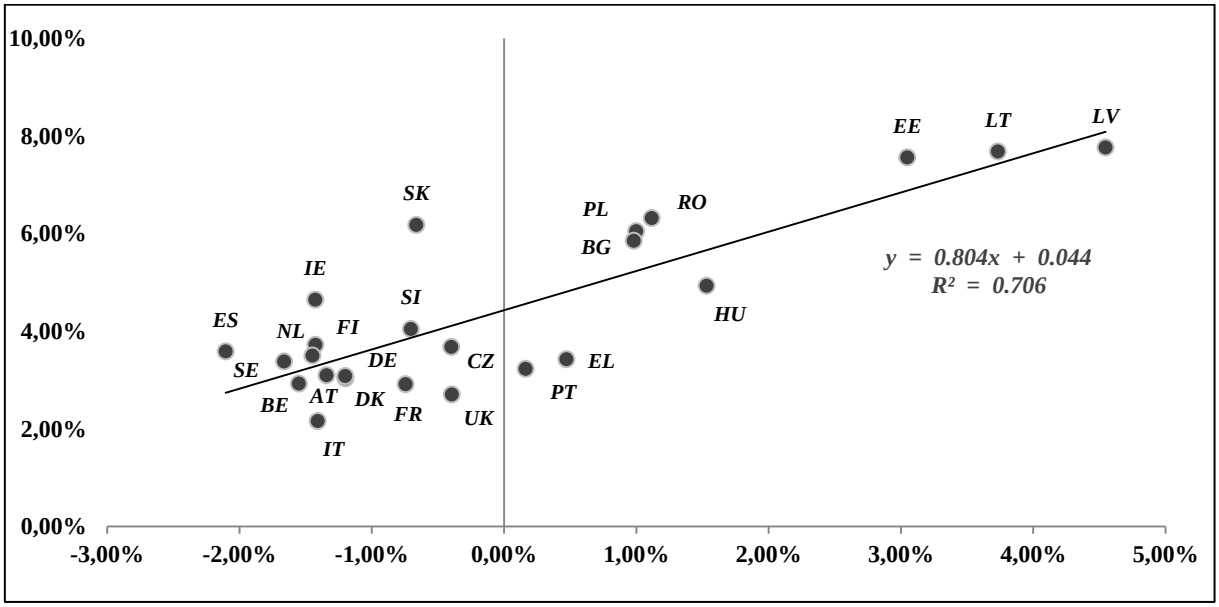

Figure 4. The correlation between the growth rates of the GDP per capita and the economic complexity index during 1995 - 2012

Source: Eurostat data, "The Atlas of Economic Complexity" data, own calculations

4.3. R&D and innovation managerial implications for SMEs

The impact of the above mentioned trends on the R&D and innovation potential is affecting in a consistent manner the SMEs sector. There are several main implications that have to be taken into account by private companies in general and SMEs in particular:

- Entrepreneurship has favorable premises for development, as there is a growing diversity of human resources that are involved in constructing complex products. Therefore, the ability to build competitive and successful teams, in order to bring innovative products on the market, or to revolutionize how the processes work, is on an upward trend. If mixed with proper financing and adequate public policies for supporting entrepreneurship and SMEs, there is high probability that the Romanian business ecosystem will become one of the most competitive and dynamic in the EU.
- The accumulation and retention of know-how is a quite costly encounter and needs, most of the time, an extensive organizational structure. This constraint does not suggest that the SMEs are doomed, but there are realities that emphasize the necessity of consolidation. Consolidation can be achieved not only by mergers and acquisitions, but also by building networks, clusters and poles of competitiveness.

In this context, the managerial implications for SMEs regarding R&D and innovation could be summarized in the following five categories that contain both opportunities and challenges:

1. There should be more resources allocated for building networks and clusters with other important stakeholders. Such an approach is justified by the need to accumulate and retain vital know-how, skills and human capabilities within the extensive system of the organization. Fostering collaboration is one of the most acute imperatives for Romanian SMEs.

2. Developing R&D and innovation projects in collaboration with others and with the support of the EU funding. In the current situation, we cannot ignore that the involvement of the public authorities in the free market is quite sensible. There are a lot of issues to be discussed, but the pragmatic conclusion is that, regardless of our ideological choices, there is an objective medium and long term opportunity of funding R&D and innovation with the support of public resources. A logical extension of the above mentioned elements is that the SMEs have to develop an internal capability to elaborate and execute projects.

3. Shaping the organizational culture in the direction of fostering creativity and collaboration among the employees. Although it raises a lot of challenges, applying managerial methods for stimulating creativity is mandatory for an organization that aims to be competitive and successful. Just as an exemplification, we present you a short list of such methods – brainstorming sessions, financial incentives for employees to develop new ideas, job rotation of staff, multidisciplinary or cross-functional work teams, non-financial incentives for employees and training employees on how to develop new ideas or creativity.

4. SMEs should develop strategies that integrate R&D and innovation. Therefore, the objectives must be analyzed in the context of the challenges imposed by the necessity to innovate and build competitiveness.

5. SMEs have to allocate time and resources for acquiring new technologies. Integrating the new technologies within the business model of a small and medium enterprise is a difficult job, but it has the potential to generate a new growth cycle for the organization and, sometimes, even reinvent it.

5. CONCLUSIONS

As our study shows, the R&D and innovation potential of Romania does not look too promising in the EU context. For the last decade, Romania's dynamic was divergent, thus putting R&D and innovation potential under a great pressure to shrink, therefore posing a challenge in terms of real and nominal convergence. But if we look at the complexity of the economy, there is clear evidence that since 1995, Romania has been in a transition process from an artificially sustained economic structure, with a large "portfolio" of products and services Romania produced in the state-owned companies, to a mainly private competitive structure of producing complex and diverse products that are market oriented. In this sense, we could argue that there are some forces that make the medium and long term perspective of Romania, in terms of R&D and innovation, look much better than the simple extrapolation of the latest trends. The accumulation of societal know-how makes it easier for new ventures to arise and for new ideas to be put in place. The shift in the positioning of the capabilities in Europe suggests that the R&D and innovation activities will follow the manufacturing, thus reversing the divergent pressures that are exercised by current imbalances in the R&D systems (incentives).

As a consequence, the amount of the societal know-how of doing complex products in a competitive way is critical for R&D and innovation because the mix of human capabilities that are involved in producing various and complex products are more likely to get involved in entrepreneurial activities with high degree of novelty and innovation, also being able to create competitive teams. At the same time, as the accumulation and retention of know-how is a quite costly encounter, SMEs are forced to consolidate, either by mergers and acquisitions, or by building networks and clusters with other important stakeholders. Therefore, there are some major managerial implications for SMEs that derive from the analysis of the Romania's R&D and innovation potential in the European context. If we were to summarize those managerial implications, we would point out that the strategic approach of SMEs has to take into account the need to innovate and conduct R&D, to build competitive teams and capitalize their creativity, and to adapt to the new technologies. All these transformations, if proven successful, would actually reinvent the organization.

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REFERENCES

Aerts, K., Schmidt, T. (2008). Two for the price of one? Additionality effects of R&D subsidies: A comparison between Flanders and Germany. *Research Policy, 37*, 806-822.

Dong, J., Yan-Nan Gou, Y. (2010). Corporate governance structure, managerial discretion, and the R&D investment in China. *International Review of Economics and Finance, 19*, 180-188.

Hausmann, R., Hidalgo, C.A., Bustos, S., Coscia, M., Chung, S., Jimenez, J. et al, (2011). The Atlas of Economic Complexity: Mapping paths to prosperity. Academic Press.

Kesavayuth, D., Zikos, V. (2012). Upstream and downstream horizontal R&D networks. *Economic Modelling, 29*, 742-750.

Lavric, V. (2012). The dynamics of R&D activities in Romania within the European context. Proceedings of the 6th International Management Conference *"Approaches in organisational management"*, Bucharest, Romania.

Lavric, V. (2013). The dynamics of R&D human resources in Romania within the European context. Proceedings of the 7th International Management Conference *" New Management for the New Economy"*, Bucharest, Romania.

Lin, C., Lin, P., Song, F.M., Li, C. (2011). Managerial incentives, CEO characteristics and corporate innovation in China's private sector. *Journal of Comparative Economics, 39*, 176-190.

Martinez-Roman, J.A., Gamero, J., Tamayo, J.A. (2011). Analysis of innovation in SMEs using an innovative capability-based non-linear model: A study in the province of Seville (Spain). *Technovation, 31*, 459-475.

Nicolescu, O. & Nicolescu, C. (2011). *Organizația şi Managementul bazate pe cunoştințe - Teorie, metodologie, studii de caz şi baterii de teste*. Bucharest: Editura Pro Universitaria.

Nobelius, D. (2004). Towards the sixth generation of R&D management. *International Journal of Project Management, 22*, 369-375.

Schwartz, M., Peglow, F., Fritsch, M., Gunther, J. (2012). What drives innovation output from subsidized R&D cooperation ? – Project level evidence from Germany. *Technovation, 32*, 358-369.