

Spatial and Systemic Perspectives on Innovation

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Abstract

Innovation has been always in the public debate. Everybody agrees that without innovation there is no progress, companies are less competitive, productivity decreases, it is more difficult to give solutions for socio-economic and political problems. Innovation is not a linear process anymore. It involves organizational changes, strong relations between producers, suppliers and customers, proximity advantages which facilitate the knowledge transfer and sharing. In international comparisons regions and countries are analyzed based on their innovation systems. In this paper we discuss the elements of an innovation system and the role of universities as a main provider of research outputs and development solutions.

Keywords: innovation, competitiveness, regional innovation system, university

JEL Classification: O30, R10

1. Introduction

The economic crisis that started in 2008 opened new discussion chapters and brought again into attention the importance of productivity, new sources for competitive advantages or the need for investments in research, development and innovation. Countries like Romania need structural reforms, the increase of sector public efficiency, bureaucracy reduction, diminishing the disparities between regions etc. One solution is to focus more on the innovation system both on national and regional levels, and to develop institutions, cooperation, networks that help to achieve the growth objectives.

In the past producing qualitative goods was a guarantee for competitiveness. However today we refer to some trends that put pressure on companies and nations to improve their efficiency and effectiveness. Because of globalization and outsourcing, companies need more than good products and services to survive; they require minimum costs and increased productivity. Innovation is regarded as a solution; it is driven by the consumer expectations and competition. New and improved goods and services can increase the living standards, improve the work conditions and help the development of the society.

In this paper we focus first on the innovation process, than we define the national innovation system and at the end we search the regional innovation system and the role of universities.

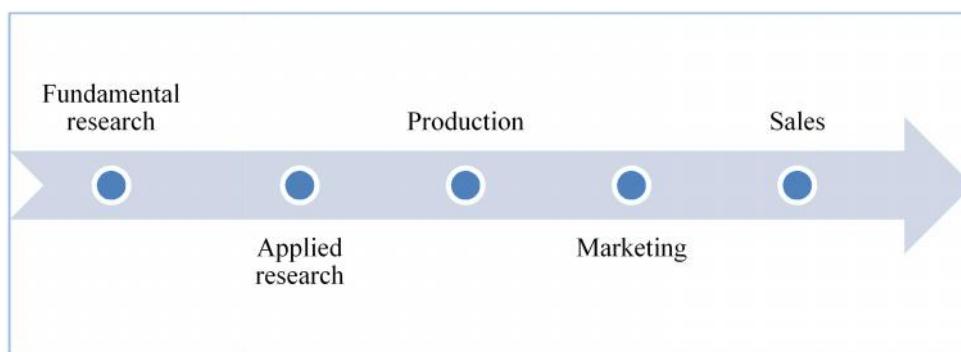
2. The Innovation Process

The importance of the industrial policy in international comparison, the evaluation of companies based on the performance in research and development, the tendencies for

liberalization and globalization, the orientation of the regional policy towards technology and innovation imposed a new thinking about the national economic policies and definition of the competitiveness concept.

Traditionally, innovation is considered a linear process, which starts with fundamental research, continues with applied research and production and ends with marketing and innovation selling. In the modern economy innovation is the result of an interactive learning process between companies with business relations or actors involved in a technological cooperation between companies, universities and the state authorities. Therefore it is necessary to monitor and identify the basic concepts of innovation: knowledge (as main resource), interactive learning and knowledge transfer. This last component is understood, it happens on constant basis between business partners, universities and industry etc.

Figure 1. The linear model of innovation



Source: Adapted from Maier (2006)

Lundvall (2007) considers that innovation is a complex concept influenced by a series of elements. We mention here:

- *the educational system and training* – education is the base of any system, especially innovation system, it is responsible for delivering specialized work force, for adapting the specializations and programs to the market needs;
- *the research and development system* – research gives solutions for the problems and for progress; in general, public financed research is influenced by the national priorities;
- *the financial system* – assures the finance of education and research, but also the access of small and medium enterprises to credits for personnel development, new production facilities, research laboratories;
- *producers networks* – can influence the opinion and position of producers on economic, social and political issues; it focuses also the relations between customers and producers, the more sophisticated expectations and demands of customers;
- *interaction rules* – relations within a cooperation for innovation are observed in the knowledge and technological transfer process;
- *relations of the companies with local, regional, national and international actors*.

Ortiz (2012) emphasizes that innovation is analyzed based on three paradigms. First, the technological paradigm where innovation, know-how and learning are competitive advantages for companies and regions. Second, the organizational paradigm underlines the role of networks, of competition and cooperation, and also of relational and social capital when developing a national innovation system. And third, the territorial paradigm

specifies that proximity brings in front the competition between territories and regions. In the context of a national innovation system the concept of learning regions becomes more important; these are regions where companies have the possibility of learning due to proximity and strong cooperation with suppliers, clients and competitors (Maskell and Malmberg 1999).

The innovation process was modified in time because of the technological changes. Nowadays innovation is a dynamic and complex process, based on feed-back, interaction mechanisms between science, technology, learning, production and demand. So, all actors involved are part of the innovation process, producers, universities, public research institutions, suppliers, customers, certification organizations, state authorities. The dispersion of technology (information and communication technology, biotechnology, new materials) shortens the product life cycle, influences the customer expectations and the access to complex products and services. Therefore, technology and innovation are now important components in the competitive strategy, and the role of the state becomes more important in development policies for improving the innovation capacity of companies from underdeveloped regions.

3. The National Innovation System

The linear model of innovation is not valid anymore, in reality the steps in the innovation process are influenced by new knowledge and discoveries, by the experience and competencies of people involved etc. Innovation is the result of a complex process and interaction between companies and regions, between organizations and persons. Companies do not innovate in isolation, but as a consequence of interaction with different economic actors (universities, research and development institutions) and due to a dialogue and feed-back system. Partners in innovation accept also the formal factors (legal frame, regulations) and the informal factors such traditions, norms, conventions. At the macroeconomic level the relations between different actors with the scope of research, development and innovation are united and analyzed under the concept of national innovation system. This system exists in a form or another in any country and follows objectives like generation and diffusion of new technologies and solutions for the society problems. The concept of national innovation system was adopted especially as a consequence of several studies (OECD, 2007, 2010) that compare research and development activity and the number of patents in different countries worldwide.

The national innovation system is defined from the relations and networks perspectives. Freeman (1987) emphasis that such a system is a network between institutions from the public and private sector, with interactive activities and the objective of initiating, importing, modifying and diffusing new technologies or Metcalfe (1995) sustains that a national innovation system is a set of institutions that contributes to the development and diffusion of new technologies, it is a system that creates and transfers knowledge, competencies.

Lundvall (2002) considers that the national innovation system must be analyzed from a narrow and broader perspective. The first approach includes organizations and institutions involved in research and development activities, the second approach takes into account all the aspects and components of an economic system implicated in learning, searching, exploration (production system, marketing system, financial system) (Lundvall, 2010).

The national innovation system in the narrow sense comprises institutions and organizations involved directly in the innovation process:

- the state at all levels, especially institutions responsible for development policies
- intermediates, e.g. research associations, as facilitators of the dialogue between the state and researchers
- private companies as financers
- universities as knowledge providers
- other organizations with an active role in research, development and innovation (knowledge transfer bureaus, patent offices, training organizations etc.)

The broader approach of the national innovation system refers to macroeconomic factors that influence its efficiency and success. These are socio-cultural factors such as education, attitude towards communication with the social actors, openness for cooperation or the relations system; economic factors that include the finance system, monetary policy, investment policy or labour force market and the legal and political factors that shape regulations, the legislation of research and innovation or the national policy and strategy regarding research and development.

We know that in the modern economy, the most important asset and profit source is knowledge. As a consequence the most important process is learning (Lundvall, 2010). Because learning is an interactive process, a social process, it is influenced both on institutional and cultural aspects. A national innovation system means relations, contact between persons, and the fact that it bases on learning which is a social process transforms it also in a social system.

The national innovation system is dynamic because it relies on feed-back, dissemination and knowledge multiplication. There is the presumption that it covers the entire country, but in the context of regional development it is preferred a regional approach and observation. The difficulty in managing and analyzing a national innovation system comes from the lack of a clear measurement of its efficiency. In the most cases, indicators like expenditures with research and development in GDP give information about the system. But this indicator shows only an input value, and does not comprise all the investments made in research and development. In the last years, analysts added other indicators: number of registered patents (or to be registered), percentage of new products in the turnover of the company, proportion of high-tech products in the export of the country or region.

In capitalism, innovation is a fundamental phenomenon. The state is active in the innovation policy based on the presumption that innovation contributes to economic growth. Competitiveness on long term reflects the capacity of a company or a nation to innovate. We may state that innovation is the base of competitiveness.

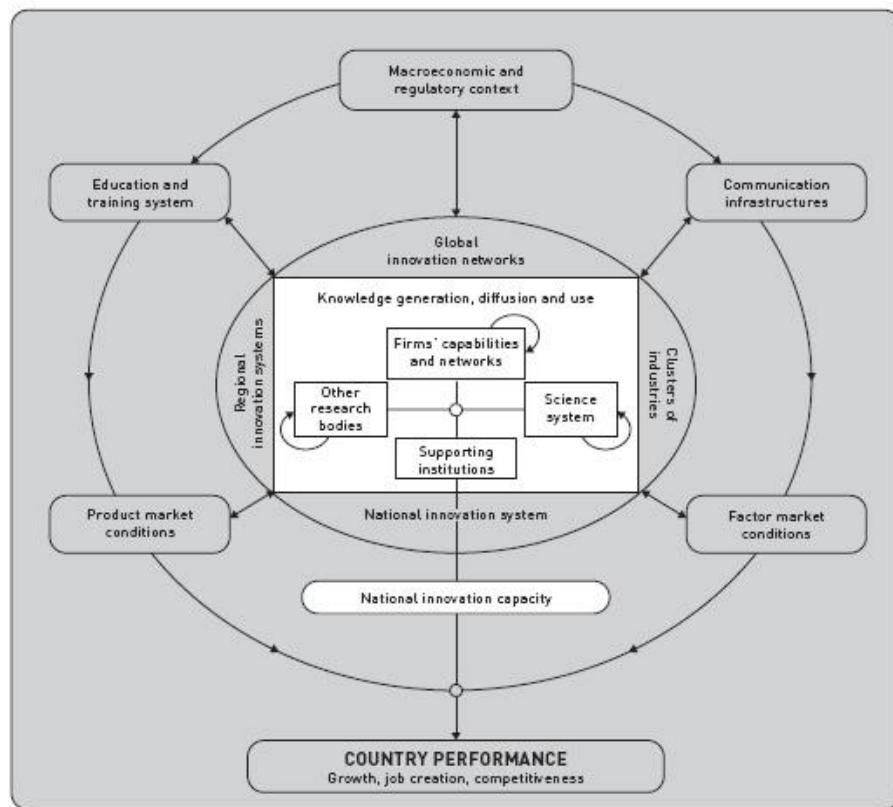
The national innovation system is a social system with interdependencies between numerous and diverse partners and it is formed of:

- a) the internal organization of the company, especially the information flux, decision making process, learning process;
- b) relations between companies, e.g. cooperation relations between producers and suppliers, between producers and customers;
- c) the public sector with the role of facilitating the interaction between diverse economic and non-economic actors;
- d) institutional frame in the financial sector and the flexibility in credits, risk attitude, in general, and for innovative products;

- e) the intensity and organization of research and development, the number of participants in these activities;
- f) the education and training systems, access to new knowledge, training the employees for a knowledge-based society, knowledge transfer etc.

All these elements influence the way companies organize, form and participate in networks, and their experience and history is reflected in the educational system and infrastructure for research, development and innovation.

Figure 2. The model of national innovation system



Source: OECD (1999)

In real life, there is not an ideal model of national innovation system. There are always problems and barriers that hinder the performance in innovation. For instance, in Romania we observe the lack of infrastructure (few companies have modern equipment, many research institutions have been closed), a minimum technology and knowledge transfer (there are few transfer bureaus and they are not very visible on the market), the technological inertia (some companies concentrate on one product, multidisciplinary research is seldom used), informal rules (different norms and visions), cooperation and communication in the network, the internal capacity of partners to develop and adapt new technologies on long term is underdeveloped. The efficiency of a national innovation system is observed in the creation, dissemination and absorption of knowledge. In a modern innovation system, the state goes from the investor role to the facilitator role. The legal frame and conditions for companies, entrepreneurship, competitiveness, labour force and social capital are more important in this system. The efficiency increases rather with the introduction of legislative packages than through isolated instruments for a region or another.

According to official reports (IUS, 2012, EFI, 2012) that compare Member States of the European Union and other developed economies (China, USA, Canada, Australia, Brazil, Russia etc.), the European countries are less productive and heterogeneous in research and innovation output. We observe a high difference between Scandinavian countries and the rest of the Member States, mainly in the percentage of GDP allocated to education which exceeds 6% of the GDP. Finland allocates 6,8%, Norway 7,3%, Sweden 7,3% (World Bank, 2012), where the New Member States invest around 2-3% of the GDP (e.g. Bulgaria, Romania). The objective of the Europe 2020 strategy is the creation of an Innovation Union and high investments in research, development and innovation. One decision was to allocate 3% of the GDP, a level that only Germany and the Scandinavian countries reached and made of them so-called innovation leaders. The difference between the Member States is a consequence of the low attraction of companies to research and development activities. Therefore, the simple budget increase is not sufficient and each Member State should take into account the specific conditions, internal needs and resources develop a national innovation strategy with feasible and measurable objectives. It is recommended also to introduce diverse specializations, to intensify the cooperation between research institutes and companies, to introduce new administrative structures, to improve the conditions for achieving a higher competitiveness and attract foreign investments (EFI, 2012, p.12).

Although universities are important components of a national innovation system, not all Member States develop programs for sustaining the in the national and international competition. One positive example is the program Exzellenzinitiative in Germany. It was launched in 2006 and a budget of 1,9 bn. € for six years. The last call began in 2012 and has a budget of 2,7 bn. € for five years distributed to 39 universities (DFG, 2012). The objective of this program is the increase of the international visibility of German universities and the modernization and strength of the position on educational and research markets. The program finances doctoral schools, clusters and especially the internal research and development infrastructure, and so-called *concepts for the future* (Zukunftskonzepte) of universities with new research profiles. In Romania we cannot find a similar program, and the lack of a unitary vision regarding the role of universities in the society makes a weak national innovation system without noticeable performances.

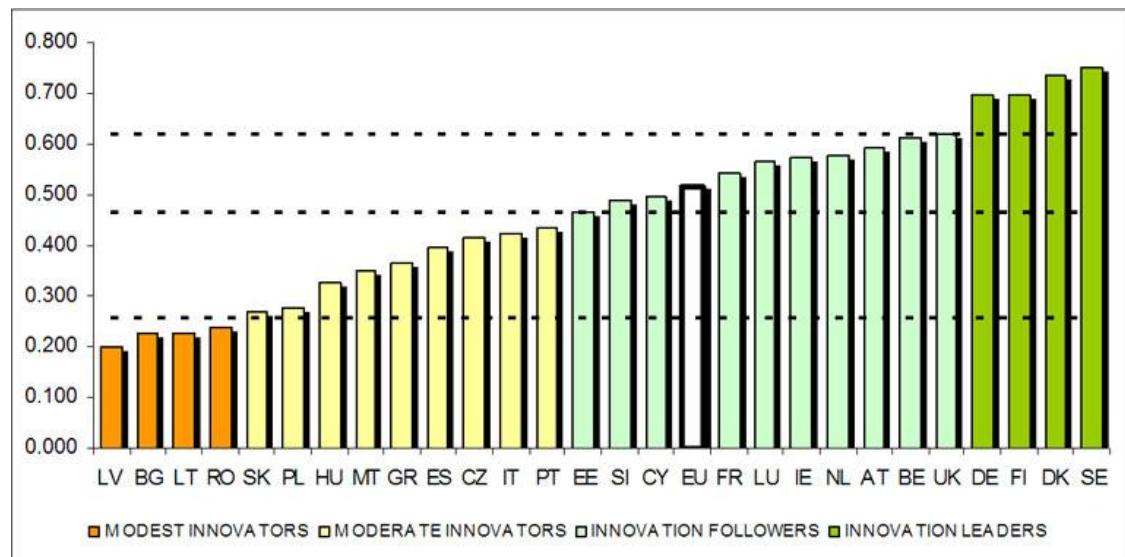
Innovation Union Scoreboard (2011) is a periodical study of the innovation policies in the EU Member States. The comparison is made on a series of indicators that give input about (Dan, 2012):

- 1) *facilitators* – these indicators capture the principal aspects that determines innovation; *human resources* (number of doctoral degrees, population between 30-34 years old and with tertiary education, and the population aged 20-24 with secondary education), *attractiveness and dissemination of research* (co-publications in international scientific magazines, number of non-EU doctoral candidates registered in universities), *finance and support* (expenditures with research and development in the public sector and the implication of the private sector in finance programs);
- 2) *company activity* – offers information about the internal innovation activity, research and development; the main indicators are expenditures with R&D in the private sector, expenditures with innovation in and outside small and medium enterprises, public-private scientific collaborations, the number of patent applications, registered trademarks and design;
- 3) *outputs* – show the efficiency of the innovation activity in a company and offer information about innovations and economic effects; important are the number of

small and medium enterprises that register new products, marketing innovations, new processes, hiring people in knowledge-based activities, services export, sales of new products and patents, export revenue from licenses and patents

Based on IUS results the Member States are classified in four performance groups the innovation leaders, the innovation followers, the moderate innovator, and the modest innovators.

Figure 3. Innovation performances of the Member States



Source: IUS (2011)

As observed in **Figure 3** the group of innovation leaders includes the Scandinavian countries (Denmark, Finland and Sweden) and Germany. These countries register constant performances in the analyzed fields (education, research and development, patent registration etc.), they have equilibrated innovation systems. The moderate and modest innovators have important weaknesses in their national innovation systems, the SMEs contribute in a smaller percentage to research, introduce rarely new products or processes. But, we observe also that the modest innovators register the highest rate growth which demonstrates that the convergence process functions.

4. The Regional Innovation System

The region is defined in accordance with the economic and political objectives of the state, the interests of the local community, national and international competition etc. The region has a determined dimension, it is homogenous in some aspects, and it differentiates from other zones by specific characteristics and has an internal grade of cohesion (Cooke, 2001).

The concept of regional innovation system is relatively new and has been introduced in the 90's (Maier *et al*, 2006). The necessity of this concept comes from the fact that a national innovation system is influenced by the specific characteristics of a region. Studies from EU (2010, 2011) and OECD () reveal different performances between

regions of a country or the discrepancies in research and development between urban agglomerations and peripheral zones in a country (Maier *et al*, 2006). On the other hand, in many Member States the industry concentrates in particular zones (e.g. mining – Valea Jiului, Romania, wine production – South of France) and networks are build between local suppliers, customers, competitors appear. The transfer of tacit knowledge is based on trust which is facilitated also by proximity. We know that the accumulation and dissemination of knowledge (spillover effect) is dependent from space. Porter (1998a, 1998b) demonstrates that the strong position of USA in research and development is a consequence of regional innovation systems that comprise inclusive clusters. We emphasize here that in regional development the innovation orientation becomes more important and clusters are promoted as a development platform for R&D activity.

According to the literature, a regional innovation system has three subsystems (Lassnigg *et al*, 2012). The subsystem for generation and diffusion of knowledge includes education and research institutions, technological transfer organizations and offices for labour force trainings and reconversion in the region. The subsystem of knowledge utilization refers to activities of companies and organizations localized in the region. And the subsystem of the regional policy focuses on the public institutions responsible for promoting and sustaining research, development and innovation activities in the region. All these three subsystems must be analyzed in a regional, socio-economic and cultural context.

Cooke (1997, 1998) has another view and states that a regional innovation system includes various elements such as regional industry (branches of multinational companies, small and medium enterprises), the technological offer of universities and research institutions, innovation services delivered by bureaus for technological transfer, educational programs orientated towards technique, consultancy, financial offers from private and public sources, venture capital, R&D activity of companies, relations between customers, suppliers, companies and competitors. All these elements are influenced further by the regional environment and a series of factors: economic sectors in the region, dimension of the companies, innovation culture, living standards, education level of employees, infrastructure. Plus, the regional innovation system is also influenced by macroeconomic factors and national decisions about R&D activity and development priorities of the country etc.

The university role in the regional innovation system is highly debated in the literature (Boucher *et al*, 2010, Benneworth *et al*, 2005, Benneworth *et al*, 2007). In the case of big companies, things are much easier, they benefit constantly from a knowledge and technological transfer (e.g. by financing directly research laboratories in universities). The situation of SMEs is much complicated, they have limited access to research results (lack of materials, financial resources and relations) and this is where the university should have a more active role (Uraya, 2010).

Therefore the concept of the regional innovation system should concentrate not only on the commercialization function of the university but also on market relations or participation in networks (from research cooperation to clusters). In comparison with the entrepreneurial university interested in the commercial and financial aspects of research, an active university at a regional level is preoccupied by the knowledge transfer without expecting a material compensation. The role of universities in a regional innovation system is influenced by internal factors (vision, mission, organization, human resources, strategy etc.) and by external factors. The demand for academic knowledge and research is influenced by the regional economy, industry structure and absorption capacity of enterprises in the region. For instance, in the economic sectors with synthetic knowledge

innovation appears as a result of a learning system of *Doing-Using-Interacting*. Important are experience, informal learning processes, application and combination of new and old knowledge, cooperation with customers and suppliers. Sectors that rely on analytical knowledge (high-tech sector) apply the model of *Science-Technology-Innovation*. In this case dominates the search for new ideas and modes of knowledge applications through interactions with universities and research institutions (Lassnigg *et al*, 2012). In other words, not all sectors have the same absorption capacity and new knowledge development, and not the same demand for university research. But even so, the university can contribute in a way or another to development. The simplest way is the introduction of a third mission, besides teaching and research.

From the perspective of a regional innovation system, universities are capable to change and shape the existing networks and the outputs of a region. Cooke and Piccaluga (2004) (cited in Arbo and Benneworth, 2007) state that a regional innovation system can be divided into knowledge production sector (represented by universities, research laboratories, commercialization offices, knowledge transfer bureaus) and knowledge usage sector (companies and development offices).

Boucher *et al* (2003) emphasize that the link between a university and a region is very complex, and the success of the last one depends on the involvement of institutions and organizations in the knowledge dissemination, in sustaining cooperation, and the university is described as an important factor in the regional knowledge-based development.

Romanian universities have to adapt now to an industry that develops in the direction of knowledge intensive activities, on commercialization of information and knowledge. The notion of development moved from centralization (the state was the research initiator, the industry was responsible for technological transfer and the university for the labour force specialization) to a model based on cooperation. The state is transferring the decision making process to a regional level, the industry acts towards innovation and technological transfer, the university is more active in the society, in research dissemination, in community development or entrepreneurship initiatives.

We observe that Romanian universities are influenced in their regional actions by the connectivity that exists between their offer (study programs, specializations) and the real life of the region (demand for labour force, economic problems etc.), by the type of the region (we presume that an underdeveloped region cannot offer so diverse development opportunities, therefore is not attractive for the graduates), the existent networks (formal and informal links between regional actors) and by the local competition (especially from the side of private universities).

Based on the observations of Boucher *et al* (2003) we state that in Romania universities are recognized as part of the regional identity (e.g. strategy documents of the North-West Development Agency), but the role in the regional governance is not clear enough. Further, the migration of students and labour force is influenced by cultural, economic and social factors. At the beginning, universities were build on geographical criteria; but, in these days, people choose their future university based first on socio-economic criteria. The attractiveness of the local and regional labour force market, the living standards and the income forecast are still major factors in the decision of the candidates. Romanian universities must involve more in the local and regional culture, for instance people with tertiary education look for a better cultural life and diverse offers. The weaknesses of the Romanian universities in the context of a regional innovation system come from the limited dialogue and link to the industry, the rare contact between professors and

companies, the missing technological transfer bureaus and few entrepreneurship programs. Because of this Romanian universities are sometimes neglected or not so implicated in the regional development process; they do not have the status of a reliable partner for the society, do not determine or influence the regional policy.

5. Conclusions

In this paper we presented the modern concept of innovation and the implications of it on national and regional level. The innovation system is formed by institutions, organizations that are located in proximity, exchange information, transfer knowledge, cooperate with all regional actors and share the same objectives for competitiveness and economic growth. Universities play a major role in the innovation systems of a country and besides teaching and research they are more active in the society. This is put under the umbrella of a so-called third mission that promotes the contribution of the university to the society, the entrepreneurial activities, and the innovative side with a focus on research contracts. As mentioned before Romanian universities have to reposition in the context of a strong international competition and act more as a reliable partner for the society and local and regional companies.

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