

## THE ROLE OF INNOVATIONS IN SUSTAINABLE DEVELOPMENT OF STATE ECONOMY

**Irena Vaivode, Vitalijs Jurenoks, Vladimirs Jansons, Konstantins Didenko**  
**Riga Technical University, Riga, Latvia**

### Abstract

More than 100 indicators are intended to give an overall picture of whether the European Union has achieved progress towards sustainable development in terms of the objectives and targets defined in the strategy. Innovations have a significant role in the international competitiveness of nations. Nowadays innovation is not attributed only to high technologies, but also to the creation and introduction of new ideas in every field of activities, so it becomes more important that the competitiveness of countries involves increasingly large number of inhabitants in the process of creative activity. Economic system with higher social mobility means also higher creativity of the society because each capable, creative person even from the lowest classes of the society has an opportunity to create and prove his or her ideas. Thus in present conditions not countries with the lowest wages, but countries with the highest equality of possibilities are most successful because they are able to ensure creative activities for as large number of inhabitants as possible. The link of international competitiveness to sustainable business models resides in two key factors in the innovation system that drives many of the competitiveness factors. These two factors are entrepreneurs and governments seeking to establish markets for sustainable innovations that start at the national level but seek diffusion to the global level. Latvia is characterised by a very weak performance in terms of Research and Innovation in comparison to the EU average. While a strong and innovative industry is a means to ensure investment in R&D, Latvia is characterised by a weak funding and participation of industry in R&D. It is essential to improve cooperation between two key actors in the innovation system that drives many of the competitiveness factors - entrepreneurs and government.

**Key words:** sustainable development, innovations, economic systems.

**JEL:** O33, Q01.

### Introduction

The basic idea of Sustainable Development Strategy of Latvia until 2030 invites to satisfy the needs of the present generation, balancing public welfare and environmental and economic development interests and concurrently ensuring the observation of the environmental requirements and the preservation of natural diversity in order to avoid the reduction of possibilities to satisfy the needs of future generations. In order to achieve these goals, for the intellectual and creative potential of a person to change into growth of innovative, energy efficient and competitive economy, the economic model must change. In most of the cases creation and distribution of innovations is not the result of one particularly talented individual – more and more people get involved in the process, thus a crucial precondition of success is the ability to co-operate, openness, knowledge and creative activity. Also users of services and products become involved in the creation of innovations with different skills, knowledge and world outlook. Mass creative activity as instrument means that creative abilities, knowledge and ideas of any inhabitant of Latvia should be used in the creation and distribution of diverse innovations. It will be possible only in case if culture oriented towards wide co-operation is created, as well as new platforms promoting co-operation are offered in innovation policy, state administration, education and culture.

More than 100 indicators are intended to give an overall picture of whether the European Union has achieved progress towards sustainable development in terms of the objectives and targets defined in the strategy. Groups of indicators that have been identified as headline indicators:

- **Socio-economic development** (growth rate of real GDP per capita);
- **Sustainable consumption and production** (resource productivity);
- **Social inclusion** (people at-risk-of-poverty or social exclusion);
- **Demographic changes** (employment rate of older workers);
- **Public health** (healthy life years and life expectancy at birth);
- **Climate change and energy** (greenhouse gas emissions, share of renewable energy in gross final energy consumption, primary energy consumption);
- **Sustainable transport** (energy consumption of transport relative to GDP);
- **Natural resources** (common bird index, fish catches taken from stocks outside safe biological limits: Status of fish stocks managed by the EU in the North-East Atlantic);
- **Global partnership** (official development assistance as share of gross national income);
- **Good governance.**

## The role of innovations in the sustainable development of State economy

The competitiveness of state economy is generally assessed in terms of the capability to maintain a position of surplus in the international trade balance. Innovation plays a role in the international competitiveness of nations. The link of international competitiveness to sustainable business models resides in two key actors in the innovation system that drives many of the competitiveness factors. These two actors are entrepreneurs and governments seeking to establish markets for sustainable innovations that start at the national level but seek diffusion to the global level. Thus, competitiveness is dependent on the ability of governments to design and implement appropriate policies and framework conditions to support entrepreneurs to implement new sustainable business models with new technologies and services.

The successful integration of cross-cutting issues such as sustainable development in governmental practice can be described as a function of:

- leadership: governmental institutions have to develop an underlying vision; and concretize this vision further by setting overall objectives; this process has to be backed by a high-level political commitment.
- planning: governmental institutions have to set up a process to identify the means of achieving objectives (institutional mechanisms, programmatic structures, and specific policy initiatives).
- implementation: governmental institutions have to employ and finance a mix of policy initiatives regarding to the requirements of planning.
- monitoring, review, and adaptation: governmental institutions have to develop, monitor, and report of the indicators to measure: (1) progress in implementing policy initiatives and (2) the economic, social, and environmental state of the country.

Development on the national level, have focused in detail on three major aspects of the coordination challenge, namely:

1. coordination of strategy objectives and initiatives with the national budget process;
2. coordination with other strategy processes;
3. coordination with sub-national and local strategy processes.

- a) **Coordination with the national budgeting process.** Budget processes are central to the functioning of the government: it is the availability and spending of resources that reveals whether or not sustainable development is taken seriously. Sustainability

has to be reflected in expenditure and revenue generation. Creating incentive structures, implementing spending reviews, shifting taxes, and creating better transparency and responsibility through green budgeting are examples of the tools.

- b) **Coordinating with other strategy processes.** Governmental departments execute a variety of strategies that run independent from the sustainability process, that is, action plans, or specific targeted programs.
- c) **Coordination with other levels of the government.** Activities for strategic and coordinated action are underway at all levels of the government ranging from the local, to state, to the international level.

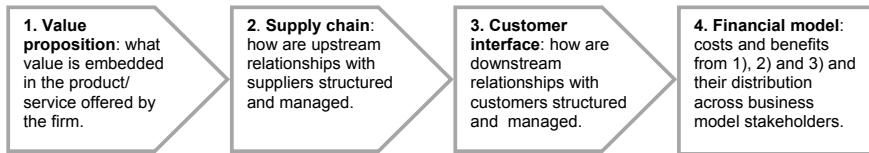
It is important to analyse an innovation as one of factors that influences the growth rate of real GDP per capita. Sustainable development requires radical and systemic innovations. Such innovations can be more effectively created and studied when building on the concept of business models. Business model concept provides a link between the individual firm and the larger production and consumption system in which it operates, interplay between the different aspects that firms combine to create ecological, economic, and social value.

Radical innovations as those that are characterized by creating new-to-the world markets that are disruptive for both customers and manufacturers, such innovations are commonly the result of an effort of a larger number of distributed R&D organizations and scientists. They are unlikely to have strong lead users or firm-internal champions to promote them. Because of this they often initially target small niche markets that are unattractive for larger firms. Generally, sustainable innovations go beyond regular product and process innovations and are future-oriented.

The innovations required for sustainable development need to move beyond incremental adjustments. Sustainable development requires the transformation of larger parts of production and consumption systems. Incremental (product- and process-related) innovations in existing production and consumption systems may lead to further gradual improvements of sustainability performance, but in the end, incremental innovation frequently does not lead to a globally optimal system configuration in a multi-dimensional production and consumption system space.

While an innovation is often distinguished from an invention by the additional condition of successful market introduction, the actual way through which firms succeed in bringing an invention to the

market. Key dimensions of successful market introduction are significant: it specifies how a firm is able to earn money from providing products and services.



**Fig. 1. The elements of a generic business model concept (bringing an invention to the market)**

1. **Value proposition:** what value is embedded in the product/ service offered by the firm:

The first model concept is the value proposition, which functions as the basic unit of analysis. The value proposition provides measurable ecological and/or social value in concert with economic value. The value proposition reflects a business-society dialog concerning the balance of economic, ecological and social needs as such values are temporally and spatially determined.

2. **Supply chain:** how are upstream relationships with suppliers structured and managed?

The supply chain involves suppliers who take responsibility towards their own as well as the focal company's stakeholders. The focal company does not shift its own socio-ecological burdens to its suppliers. This condition requires that a firm actively engages suppliers into sustainable supply chain management, which includes, for example, forms of social issue management and materials cycles that avoid/reuse wastes.

3. **Customer interface:** how are downstream relationships with customers structured and managed?

The customer interface motivates customers to take responsibility for their consumption as well as for the focal company's stakeholders. The local company does not shift its own social burdens to its customers. Customer relationships are set up with recognition of the respective sustainability challenges of differently developed markets as well as company-specific challenges resulting from its individual supply chain configuration.

4. **Financial model:** costs and benefits from 1), 2) and 3) and their distribution across business model stakeholders.

The financial model reflects an appropriate distribution of economic costs and benefits among actors involved in the business model and accounts for the company's ecological and social impacts.

Implementation and diffusion of innovations are often considered as challenges of introducing new technologies and designs, overcoming economic barriers and gaining acceptance among users, and sometimes even changing whole socio-technical

Figure 1 shows the elements of a generic business model concept according the actual way through which firms succeed in bringing an invention to the market.

systems. It is a special characteristic of sustainable innovations that they have to fit from a technical or organizational point of view, be economical and contribute to solving sustainability problems.

A business model perspective may be expected to contribute to a sustainable innovation agenda by opening up new approaches to overcoming internal and external barriers. There are three streams which appear to be most important with regard to sustainable business models: technological, organizational, and social innovation.

**Technological innovation.** Definition: sustainable business models with a focus on technological innovation are market devices that overcome internal and external barriers of marketing clean technologies; of significance is the business model's ability to create a fit between technology characteristics and (new) commercialization approaches that both can succeed on given and new markets.

**Organizational innovation.** Definition: business model change on the organizational level is about the implementation of alternative paradigms other than the neoclassical economic worldview that shape the culture, structure and routines of organizations and thus change the way of doing business towards sustainable development; a sustainable business model is the aggregate of these diverse organizational aspects.

**Social innovation.** Definition: sustainable business models enable social entrepreneurs to create social value and maximize social profit; of significance is the business models' ability to act as market device that helps in creating and further developing markets for innovations with a social purpose.

#### Tools of investigation of marketing technologies

Implementation and diffusion of innovations are often considered as challenges of introducing new technologies and designs, overcoming economic barriers and gaining acceptance among users, and sometimes even changing whole socio-technical systems. It is a special characteristic of sustainable innovations that they have to fit from a technical or organizational point of view, be economical and contribute to solving sustainability problems.

There is possibility to study forecasting accuracy when applying macro-level diffusion models to high-tech product innovations among organizational adopters. In addition, it explores whether the accuracy of macro-level diffusion models differs according to the impact of the new product.

For the past 35 years, marketing specialists have tried extending the Bass model through so-called "flexible" diffusion models which relax some of the assumptions of the Bass model; for example, the constant parameters.

The internal influence research and the mixed diffusion models:

$$\begin{aligned} \frac{dy(t)}{dt} &= p(m - y(t)) \\ \frac{dy(t)}{dt} &= q(y) (m - y(t)) \\ \frac{dy(t)}{dt} &= (p + qy(t)) (m - y(t)) \end{aligned} \quad (1)$$

where

$y(t)$  is cumulative number of adopters up to time  $t$ ;  
 $p$  – constant rate of external influence;  
 $q$  – constant rate of internal influence;  
 $m$  – maximum number of potential adopters (i.e. market potential or saturation point);  
 $dy/dt$  – the rate of diffusion at time  $t$ .

Similar to macro-level diffusion models, trend extrapolation models are constructed to consider sales or adopters as a function of time alone. The power of these models in providing descriptive notions of the diffusion process is minimal, but they are considerably simpler than macro-level diffusion models in terms of constructing quick forecasts.

The following three relatively simple trend extrapolation models will be considered in this study:

$$\begin{aligned} A_t &= A_{t-1} \\ A_t &= \alpha y_{t-1} + (1-\alpha) A_{t-1} \end{aligned} \quad (2)$$

$A_t = a_t + b_t x$

where

$A_t$  – predicted number of adopters in period  $t$  (current period);  
 $A_{t-1}$  – predicted number of adopters the previous period;  
 $a$  and  $b$  – linear constants;  
 $\alpha$  – smoothing constant;  
 $y_{t-1}$  – cumulative number of previous adopters to time  $t-1$  (one time period before);  
 $x$  – forecast time period.

Perhaps the most important difference between macro-level diffusion models and trend extrapolation models is theoretical. Macro-level diffusion

models are a result of the theory of adoption and diffusion in social systems.

In terms of the most accurate forecasting model, this model out performed all other models in virtually all situations. While somewhat discouraging for the science of forecasting, it does support the view that organizational adoption of high-tech products is difficult to predict using standard models that were designed for consumer durable goods.

The link between innovation and sustainable development is shown in Figure 2.



**Fig. 2. The link between innovation and sustainable development**

1. The link of international competitiveness to sustainable business models resides in two key factors in the innovation system that drives many of the competitiveness factors. These two factors are entrepreneurs and governments seeking to establish markets for sustainable innovations that start at the national level but seek diffusion to the global level.
2. The successful integration of cross-cutting issues such as sustainable development in governmental practice can be described as a function of several factors. It is important to analyse an innovation as one of factors that influences the growth rate of real GDP per capita.
3. Sustainable development requires radical and systemic innovations. Such innovations can be more effectively created and studied when building on the concept of business models. Generally, sustainable innovations go beyond regular product and process innovations and are future-oriented.
4. An innovation is often distinguished from an invention by the additional condition of successful market introduction, the actual way through which firms succeed in bringing an invention to the market.
5. Implementation and diffusion of innovations are often considered as challenges of introducing new technologies and designs, overcoming economic barriers and gaining acceptance among users, and sometimes even changing whole socio-technical systems. Also users of services and products become involved in the creation of innovations with different skills, knowledge and world outlook.

According to the statements 4 and 5 (see Figure 2), we can say, that innovation occurs more frequently at the point at which a product or service is moved into the marketplace where it is immediately

modified through customer interaction. In this process, new “functionality” — services, the delivery method or even product changes occur in the diffusion process. Given the need to constantly create new value through new product “functionality” or new “functionality development”, firm strategy must address the issue of how to enhance innovation at this new locus — the diffusion process. Sustainable new functionality development over time has become crucial to a firm's competitiveness. In this context, firms have to develop new functionality as early and quickly as possible; leveraging whatever innovation exists in the marketplace. According to theory, the early emergence of functionality development in this context depends on a dynamic system in which the imitator (follower) is constantly substituting for the innovator (leader).

The improvement of goods and services or even the performance of the production processes through innovation can be defined as functionality development. Since firms have to develop new functionality as early and quickly as possible; leveraging whatever innovation exists in the marketplace, mathematical models can facilitate this process. The focus may be on describing mathematically the sustainable functionality development in order to enable firms to remain competitive in a highly competitive and resource constrained marketplace. Diffusion of innovative goods and services is induced by their ability to dramatically improve the performance of production processes, goods and services through innovation. We should return to the Bass mathematical model. Based on this postulate, following function is using:

$$\frac{dY}{dt} = aY \left(1 - \frac{Y}{N}\right) \quad (3)$$

where

$Y$  is production of innovative goods and services;

$N$  – carrying capacity;

$a$  – velocity of diffusion.

While  $Y$  continues to diffuse as far as it incorporates functionality development, since  $\frac{dY}{dt} = 0$ , when  $Y$  reaches  $N$ ,  $Y$  stops diffusing when it reaches the level of carrying capacity  $N$ .

To analyse the substitution dynamism between innovator and imitator leveraging, the cumulative learning of the preceding innovation for sustainable functionality development was analysed in works of scientists. This was based on the concept of the Bi-logistic growth model which analysed two co-existing diffusion trajectories. Therefore, the following Bi-Bass model was developed:

$$Y_t = \frac{N_1 \left(1 - e^{-(p_1+q_1)t}\right)}{1 + \frac{q_1}{p_1} e^{-(p_1+q_1)t}} + \frac{N_2 \left(1 - e^{-(p_2+q_2)t}\right)}{1 + \frac{q_2}{p_2} e^{-(p_2+q_2)t}} \quad (4)$$

where

$p, q$  are innovator parameters,

$t$  – time of diffusion.

By demonstrating that functionality development decreases as time passes, it was shown that timing for functionality development emergence and its governing factors were crucial to firm strategy and survival.

6. Recommendations to key actors in the innovation system after investigation data analysis by macro-level diffusion models.

### Innovations and sustainable development of European Union, Latvia and Bulgaria

EUROPE 2020, a strategy for smart, sustainable and inclusive growth includes three priorities:

- Smart growth – developing an economy based on knowledge and innovation.
- Sustainable growth – promoting a more resource efficient, greener and more competitive economy.
- Inclusive growth – fostering a high-employment economy delivering economic, social and territorial cohesion.

Smart growth is an economy based on knowledge and innovation. Smart growth means strengthening knowledge and innovation as drivers of our future growth. This requires improving the quality of our education, strengthening our research performance, promoting innovation and knowledge transfer throughout the Union, making full use of information and communication technologies and ensuring that innovative ideas can be turned into new products and services that create growth, quality jobs and help address European and global societal challenges. But, to succeed, this must be combined with entrepreneurship, finance, and a focus on user needs and market opportunities. Europe must act to develop innovation.

R&D spending in Europe is below 2%, compared to 2.6% in the US and 3.4% in Japan, mainly as a result of lower levels of private investment. It is not only the absolute amounts spent on R&D that count – Europe needs to focus on the impact and composition of research spending and to improve the conditions for private sector R&D in the EU. Our smaller share of high-tech firms explains half of our gap with the US.

### Progress of Latvia towards meeting the Europe 2020

Latvia is characterised by a very weak performance in terms of Research and Innovation in comparison to the EU. While a strong and innovative

industry is a means to ensure investment in R&D, Latvia is characterised by a weak funding and participation of industry in R&D. Latvia's growth since independence has been very much built on low labour costs and production of products of low added value. As costs and incomes start to converge with wider EU norms, companies need to shift the base of their competitiveness. In that respect creation and growth of innovative firms is a key to economic regeneration. While other indicators such as employment in knowledge intensive

activities as % of total employment and growth of the number of PhDs progress, albeit from a low basis, they point to a real problem in internationalisation and international publication of research. The low level of Latvia's participation in the European Research Area reflects the global level of its R&D performance. Co-publications are significant with its neighbours (Sweden, Finland, and Estonia), but also with Germany and Denmark, while co-patenting activity in absolute values stayed at a low level.

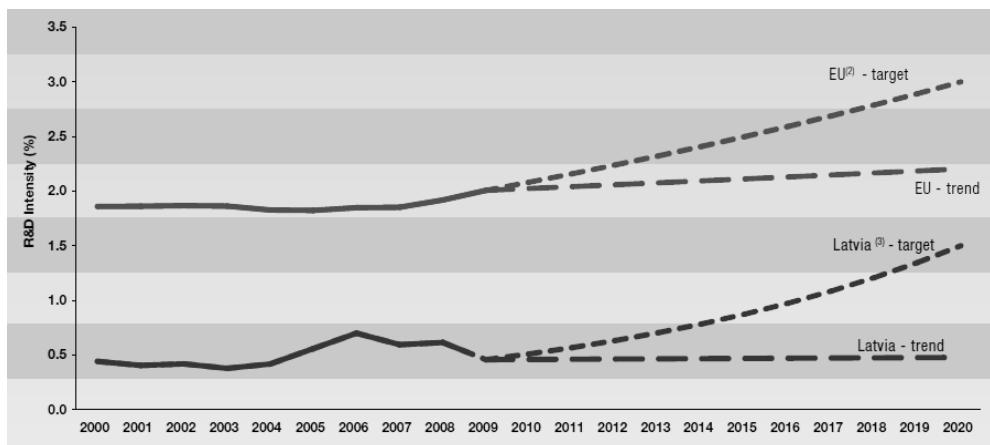


Fig. 3. R&D Intensity projections, 2000-2020, Latvia

Latvia is aware that an effort in R&D is necessary to ensure a sustainable development of the country, which has badly suffered from the financial crisis. Latvia increased its R&D intensity during the 2000-2008 period by an average annual growth rate of 4.1%, passing from 0.44% in the year 2000 to 0.61% in 2008. This increase has been fuelled thanks to an increase in public R&D investment, which rose at an average annual growth rate of 7.1% (from 0.26% to 0.46%). On the other hand, private R&D fell from 0.18% to 0.15%. However, with the deterioration of the economic situation in the country, the public and private sector investment in R&D decreased in 2009 (0.46%) and again in 2010. Figure 3 shows R&D intensity projections of Latvia, 2000-2020.

#### Progress of Bulgaria towards meeting the Europe 2020

Ministry of Economy and Energy of Bulgaria has set the main strategic goals as enhancing the competitiveness of Bulgarian industry and improving its ability to withstand the competitive pressure of the European and world markets.

The Innovation Strategy provides the exact measures to achieve these goals based on the understanding that the industry's competitive advantage could be achieved by developing, implementing and disseminating innovation, providing leading competitive position in the international

markets, meeting in advance new needs of national and international consumers.

The Innovation Strategy is the result of extensive research and analyses of a huge volume of information:

- inventory of the Bulgarian national innovation system;
- review of the regulatory framework, national strategy and policies on scientific and technological development and innovation;
- scientific, technical and innovation potential of the national industry;
- 10 examples of innovative Bulgarian companies.

The Innovation Strategy sets out ten measures for its implementation, organized into two main groups: Financial and Non-financial instruments for impact. Pending is the development of a new Innovation Strategy.

The respective state organizations have exerted a significant stimulation of the innovative processes most of all by the National Innovative Fund (NIF). Ten national strategies are elaborated and accepted up to now that are directly related to the development of innovations. The interpretation of the terms innovation is so wide not only in the innovative strategy of the Republic of Bulgaria but also in the normative documents of the National Innovative Fund (NIF) that it allows a significant subjectivism concerning also the state subsidies for activities

that are not related to the real innovations in Bulgaria. Via the NIF the state spends financial means without the possibility to control them and to check the final result from their usage, the market realization.

Despite the importance of R&D in the sustainable development of the country, Bulgaria is one of the countries with the lowest R&D intensity in the EU. Bulgaria's R&D intensity has been decreasing over time, from 0.57% in 1999 to 0.53% of GDP in 2009; i.e. around four times less than the EU-27 average. The very low level of private R&D investment in the economy is particularly worrying. At 0.16% of the GDP in 2009, having increased how-

ever from 0.10% of GDP in 2002, Bulgaria ranks the lowest in the EU. The sectorial specialisation in low technology sectors and the current scarcity of medium and high technology firms in the economy is responsible for this low level of private R&D. A substantial increase of the R&D spending, both in absolute and relative terms, will be instrumental for Bulgaria in order to raise the economic competitiveness and secure high-quality jobs. Figure 4 shows, that aware of the need to raise R&D investment, the Bulgarian government approved a national target for R&D intensity for 2020 of 1.5% of GDP.

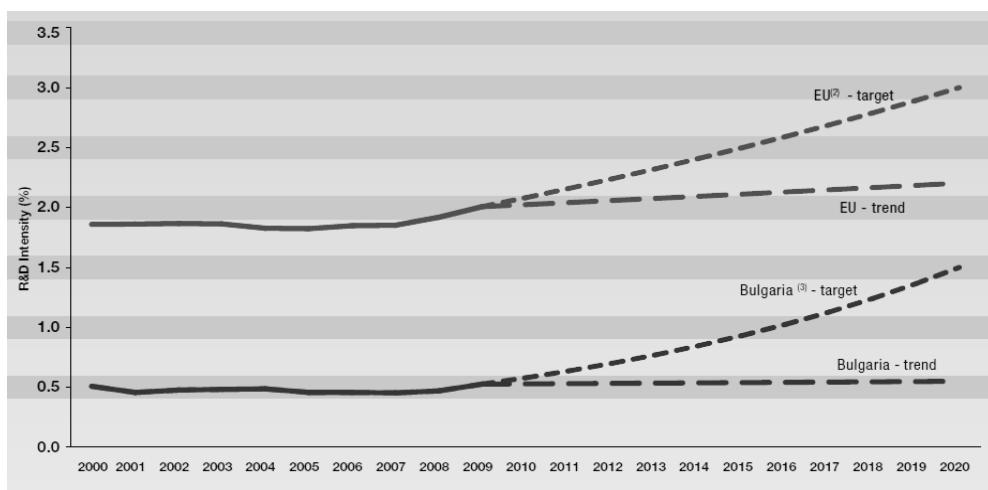


Fig. 4. R&D Intensity projections, 2000-2020, Bulgaria

In addition to the overall low R&D investment, an important challenge of the Research and Innovation system is its overall fragmentation, as reflected by the large number of research performers, e.g. universities, research institutes and institutes of the Bulgarian Academy of Science, which leads to a lack of critical mass and deficiencies in the quality of research results. Overall, Bulgaria scores low in terms of high-quality scientific publications or patents, especially in new technologies aimed at addressing societal challenges, such as the ageing of the population or climate change, and that can constitute important new sources of economic growth. As a result, the weak scientific and technological performance hinders Bulgaria's capacity to move towards more knowledge intensive, higher value added, activities. The much needed structural change will increasingly require important and efficient investments in research and innovation, as well as in education. In comparison to other similar European countries in terms of economic structure and R&D characteristics, Bulgaria appears particularly weak as regards public R&D expenditures and high-quality technological inventiveness. On the other hand, the number of researchers employed in

the system, while still low compared to the EU average, is slightly higher than in the comparison countries, and, therefore, there can be potential to raise the quality of the scientific production, should the necessary reforms be adopted.

**Common features (Latvia and Bulgaria):** Both countries are characterised by a very weak performance in terms of Research and Innovation in comparison to the EU. While a strong and innovative industry is a means to ensure investment in R&D, Latvia and Bulgaria are characterised by a weak funding and participation of industry in R&D. Country's growth since the last decade has been very much built on low labour costs and production of products of low added value. According R&D Intensity projections, 2000-2020, target of Latvia and Bulgaria is same 1.5%, the trend is 0.5%, EU-target is 3%, trend is 2.3% of GDP. R&D intensity target Latvia and Bulgaria are the countries with one of the lowest R&D intensity in the EU. As costs and incomes start to converge with wider EU norms, companies of both countries need to shift the base of their competitiveness.

Innovations in Latvia are more incremental than radical. An innovation of enterprises of Latvia

mainly improves existing products and allows them to stay competitive. A lack of radical innovations in economy of Latvia is apparent, although radical innovation lies at the heart of the economic growth of firms and nations, this would be the main objective of all enterprises. The essential task is to take into account the obvious impact of innovations to macro level of economy.

## Conclusions

1. To improve innovations performance, it is important to take into account that the link of international competitiveness to sustainable business models resides in two key actors in the innovation system that drives many of the competitiveness factors. These two actors are entrepreneurs and governments seeking to establish markets for sustainable innovations that start at the national level but seek diffusion to the global level. Competitiveness is dependent on the ability of governments to design and implement appropriate policies and framework conditions to support entrepreneurs to implement new sustainable business models with new technologies and services.
2. It is important to analyse an innovation as one of factors that influences the growth rate of real GDP per capita.
3. Sustainable development requires radical and systemic innovations. Radical innovations as those that are characterized by creating new-to-the world markets that are disruptive for both customers and manufacturers, such innovations are commonly the result of an effort of a larger number of distributed R&D organizations and scientists, they are unlikely to have strong lead users or firm-internal champions to promote them. Given the challenges posed by sustainable development, sustainable innovation will often be characterized by systemness and radicalness. Generally, sustainable innovations go beyond regular product and process innovations and are future-oriented.
4. While an innovation is often distinguished from an invention by the additional condition of successful market introduction, the actual way through which firms succeed in bringing an invention to the market. Key dimensions of successful market introduction are significant: it specifies how a firm is able to earn money from providing products and services. By demonstrating that functionality development decreases as time passes, it was shown that timing for functionality development emergence and its governing factors were crucial to firm strategy and survival.

A business model in perspective may contribute to a sustainable innovation agenda by opening up new approaches to overcoming internal and external barriers. There are three streams which appear to be most important with regard

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