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Measurement and Management of Development Sustainability

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Abstract. The basis of scientific knowledge is the sustainability of system condition or development, which were formed by discussing the basic possibilities of smart interaction between universe and human with nature, massively have spread trying to reveal the necessity for compatibility of nature laws and development needs of civilization. The article examines the identification and quantitative measurement opportunities for sustainability development of the country, as a complex system, in order to reveal the influence of the development sustainability to the efficiency of development. The pragmatic structurization of this problem and the reveal of possibilities of practical solution is the main objective of this article. The results of research on development principles of intelligent investment strategy will be submitted in order to show the smart regeneration of country's domestic resources and the rational use of integrated relations, fostering opportunities of country's territorial, political and economic independence in order to satisfy expectations of population and needs of the civilized development. Practical analysis for assessment of sustainability development and management possibilities will be illustrated by the example of Lithuania, as a member of European Union.

Keywords: development, sustainability, quantitive measurement, stochastic network model.

1. Introduction

The concept of sustainability or sustainable development is dominated as one of the most controversial concepts in scientific literature. The knowledge and researches of sustainable development often become the instrument for the generation of economic knowledges and solving the problems of region, city or state, such as survival, effective changes, and avoidance of losses. Trying to foster the sustainability of country, the new knowledge and skills should be used. Scientific knowledge is the base of the development sustainability, which was formed during the changes in the environment that promotes the knowledge, innovation and technologies integration.

In this article is formulated the idea of small country's development sustainability measurement and management possibilities, when sustainability is understood as an ability to sustain optimal allocation and regeneration of development resources taking into account and measuring impact of uncertainty. Also is revealed the influence of the sustainability development to the efficiency of sustainable development. The results of research on development principles of intelligent investment strategy are submitted in order to show the smart regeneration of country's domestic resources and the rational use of the integrated relations, fostering opportunities of country's territorial, political and economic independence in order to satisfy expectations of population and needs of the civilized development. Practical analysis for assessment of sustainability development and management possibilities will be illustrated by the example of Lithuania.

The methods used in this article: the scientific literature analysis in the area of sustainability development and measurement, theoretical and practical statement methods, stochastic network model, stochastic optimization theory and practice.

The concept and the forms of development

In general terms, "development" means an "event constituting a new stage in a changing situation" (Oxford English Dictionary 2015).

Development can be explained as a process of evolutional succession in stages, where human societies leave a rudimentary model until they arrive at a western industrialized civilization consumption model, which is considered unique and universal (Rostow 1971).

In Ribeiro's approach (2005), the word development is defined in various areas of knowledge, merges to "a state, process, well-being, progress, economic and human growth or ecological balance". The South Commission defines the

term as "a maturing and development process of self that frees the population from fear and exploitation" (Ribeiro 2005).

Both approaches are different in relation to the idea of the theme to whom development is usually seen as a phenomenon that fundamentally interests developed countries (Soares, Quantella 2008).

Bellu (2011) defines development as something positive or desirable. Development could mean the improvement of the system or separate elements, when we are talking about socioeconomic system (Bellu 2011).

From an economic perspective, Schumpeter (1984, 1985, 1989) cannot be unmentioned. He used the term development as evolution, unfolding, innovation and revelation.

Soares and Quantella (2008) would argue that there are three definitions of 'development' (see Figure 1). The first is historical, long term and arguably relatively value free – 'development' as a process of change. The second is policy related and evaluative or indicator led. It is based on value judgements, and has short- to medium-term time horizons. The third is post-modernist, drawing attention to the ethnocentric and ideologically loaded Western conceptions of 'development' and raising the possibilities of alternative conceptions.

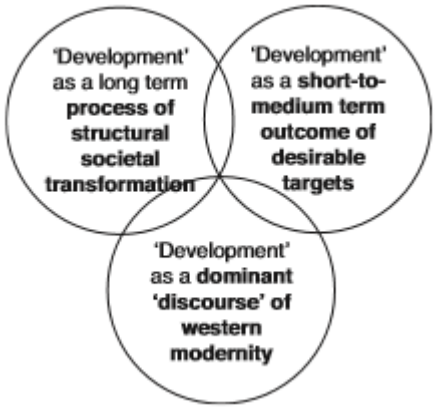


Fig. 1. Different meanings of development (Source: Soares, Quantella 2008)

The problem arises, when there is a need to measure development. It is the intrinsically multidimensional exercise. In order to solve this exercise, the development of a socio-economic system can be viewed as a holistic process that has four different types with different qualifications:

• Economic development – improvement of the way endowments and goods and services are used within (or by) the system to generate new goods and services in order to provide additional consumption and investment possibilities to the members of the system. Economic development has traditionally been seen as the first form of development. It has often been strictly associated with the concept of economic growth of the country. In fact, the growth defined in this way can be seen more as the result of an economic development process or the transformation of the structure of an economic system, rather than as a development process. Many economists provided insights and proposed models to explain how economic systems should develop to generate growth. Just to mention some stages, it is worth mentioning the contributions of Shumpeter (1911), who suggested that economic systems evolve through subsequent disequilibria due to agents, which introduce innovations, more than developing according to a pre-determined path. Ramsey (1928) set a model to maximise the consumption of future generations with endogenous savings, disutility of work and individuals with an infinite time horizon.

Solow (1956) has proposed "Long Run Growth Model", which means that, increasing the capital per unit of labour, increases labour productivity and generates growth. The main idea of the model that factors exhibit diminishing marginal productivity. And in this case, the diminishing marginal productivity should push the economy at the point where additional capital per worker would have no impact on production. The output would increase only if labour also increases. In this situation, there would be no interest in investing more because this would bring no returns. Therefore output, capital and labour would all increase at the same rate. Galor and Zeira (1993) emphasize how strong income inequalities may prevent investment in human capital leading to lower per capita output. Galor and Moav (2004) identify the replacement of physical capital accumulation with human capital accumulation, stimulated by more equitable income distribution, as an advanced stage along the development process, which sustains the so called "modern growth", as opposed to the "industrial revolution" growth.

• Human development – people-centred development, where the focus is put on the improvement of the various dimensions affecting the well-being of individuals and their relationships with the society (health, education, entitlements, capabilities, empowerment etc.). UNDP (2010) provides an aggregate concept of human development on the basis of three criteria:

1. Long and healthy life;

2. Knowledge;

3. A decent standard of living, measured by life expectancy at birth, mean years and expected years of schooling and gross national income per capita at purchasing parity.

The associated Human Development Index (HDI) is then adjusted on the basis of the inequality in the distribution of the specific features within countries, assuming that the unequal distribution of wealth is an undesirable feature of the development processes.

• Territorial development – development of a specific region (space) achievable by exploiting the specific socio-economic, environmental and institutional potential of the area, and its relationships with external subjects. This dimension of development refers to a territorial system, intended as a set of interrelationships between rural and urban areas, in a space characterised by the existence of poles of attraction for human activities (production and consumption of goods and services, but also culture and social life), and connected by information systems and transport infrastructures. When referring to production activities, poles of attraction can be characterised as "Clusters" where, for various reasons, homogeneous or closely interlinked activities are implemented. Territorial systems are open to influences from the national and supra-national contexts and from the interrelationships between territories. Territorial development implies focusing on the assets of the territory, its potential and constraints (FAO, 2005). Polices to exploit and enhance this potential play an important role in the development process.

• Sustainable development – development which considers the long term perspectives of the socio-economic system, to ensure that improvements occurring in the short term will not be detrimental to the future status or development potential of the system, i.e. development will be "sustainable" on environmental, social, financial and other grounds (Bellu 2011). The concept of sustainable development was first introduced by Brundtland (1987), who defines development as "sustainable" if it "meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainable development implies minimising the use of exhaustible resources, or at least, ensuring that revenues obtained from them are used to create a constant flow of income across generations, and making an appropriate use of renewable resources. The concept of sustainability has also been extended beyond environmental concerns, to include social sustainability, i.e. long term acceptance and ownership of development changes by the citizens, their organisations and asso-

ciations, and financial and economic sustainability.

One of the most difficult measurable types of development is sustainable development.

2. The main types of sustainable development

Many scientists (Bellu 2011; Zaman et al. 2012; Braunstein 2013; Das 2013; Rutkauskas et al. 2013; D'Souza, Ray 2014; Rutkauskas et al. 2014 (a); Rutkauskas et al. 2014 (b); Komninos et al. 2014; Braunstein, Houston 2015) try to define the main types of development and, of course, sustainable development. The review of the literature in this study area help us to identify a number of possible development types. (Bellu 2011) say that the main types of sustainable development are:

• Free-market Trickle-down Growth-led development. This type of development shows that growth, trickles-down to the poor through the normal income distribution channels. In this way, it is functioning at free markets, associated with the withdrawal of national governments. As a result, here launch the foreign trade liberalisation and promotes the foreign investments.

• Pro-poor (broad-based or balanced) growth-led development (Zaman et al. 2012). This type defines the growth, which launch from development, which is associated with an equitable distribution of income, which can be achieved through the promotion of activities generating a broad-based primary income distribution and fiscal systems. In is necessary to ensure the secondary distribution of real income, without necessarily relying on trickle-down mechanisms.

• Low-wage industry-led development (Das 2013). This type (strategy) is defined by rising growth rates, so more people can move form the low wage to high. The main characteristic of this model is capital accumulation for the promotion of heavy industry. Certain country's industry should attract more investments but in the same time need to compress the consumption.

• Low-wage labour-intensive export-led development. This type of development is based on the export of labour-intensive manufactured commodities in a context of low-wage. Here the focus is placed on export-oriented industrialisation. The essence is a global trade and investment that leads to the growth of the demand of export-led. The key aspects of these changes are globalization and trade liberalization. The goal of this type of development is the growth of productivity and competitiveness. Labour intensification leads to the higher export level (Braunstein 2013; Braunstein, Houston 2015). Labour is also intensified by the creation of smart specialisation (Komninos et al. 2014) Smart spe-

cialisation is based on evidence about industry in which country has competitive advantages, but here it is necessary to improve the existing production and technological level.

• Agriculture-based development. Agricultural growth is directly contributing to the various dimensions of socio-economic development through its contributions to the general growth of the economic system and for its specific contributions to poverty reduction. For the better economic growth it is necessary to initiate the process of structural transformation and as a result the poverty will be reduced (D'Souza, Ray 2014).

• Integrate or growth-based development. Technological changes required to support economic growth. Investment and activities generate "spillovers" by "learning-by-doing" processes generating knowledge and therefore technology improvements. Here are the demand for the integration of knowledge, innovation and technologies, which is defined in our previous works (Rutkauskas et al. 2013; Rutkauskas et al. 2014; Rutkauskas et al. 2014). Also are the need for the creation and maintenance of human capital and human factors inclusion in all processes acquiring new knowledge.

• Washington Consensus-based development. This type of development shows that exactly development is only possible when countries are able to benefit from the 'globalised' environment. Therefore, as a result starts the liberalization of foreign trade, privatisation of public assets, applying lower marginal tax rates and broaden the tax base. The key moment of this type is the need for foreign direct investment attraction.

• Emigration-based development. Countries with a weak industrial sector may find themselves with excess labour because the primary sector is not capable of absorbing all the existing labour force even at subsistence wage levels, due to the lack of complementary factors (e.g. capital, infrastructures) and/or natural resources (land, water etc). Their development (including their social stability) is substantially based on consumption/accumulation mechanisms driven by remittances of expatriated workers.

• Immigration-based development. Countries able to attract labour thanks to financial resources accumulated through the export of their natural resource base or thanks to a consolidated industry-services system (physical capital, know-how etc) may develop further by attracting labour from excess labour countries and extract the surplus to further feed their development process.

• FDI-based development and others. A further consideration applies to financial sources that may be used to fund capital accumulation to start up and

feed development processes. Further to funds from exports, selected countries rely heavily on FDI.

The above-mentioned types of development are far from being mutually exclusive. Each of mentioned types in certain country have been adopted at a certain time and refer to different phases of economic processes (funding, production, trade). All of development types have a different dimensions of development (economic, social) and impinge on different endowments and resources. So, the most appropriate type of development can be endogenous growth-based development type which is based on integration of knowledge, innovation and technologies seeking for the best solution allocating the investment unit and trying to reach the highest productivity level.

3. The models of development

Moving towards sustainable development presents tremendous challenges. The achievement of sustainable development requires to use more efficient methods, productivity level and more detail information about internal and external factors. So, here are the necessary to define some models of sustainable development. Models help us gather, share and analyse information. We also can coordinate the work and ensure professional training in general.

The Egg of Sustainability. The 'Egg of Sustainability' model was designed in 1994 by the International Union for the Conservation of Nature, IUCN. Dimension of Sustainability Social Environment Economy illustrates the relationship between people and ecosystem as one circle inside another, like the yolk of an egg. This implies that people are within the ecosystem, and that ultimately one is entirely dependent upon the other. Just as an egg is good only if both the white and yolk are good, so a society is well and sustainable only if both, people and the eco-system, are well. Social and economic development can only take place if the environment offers the necessary resources: raw materials, space for new production sites and jobs, constitutional qualities (recreation, health etc.). Ecosystem is therefore to be regarded as a super coordinated system to the other dimensions of the triangle or prism models: social, economic, and institutional. These latter can only prosper if they adapt themselves to the limits of environmental carrying capacity. Thus according to this model: sustainable development = human well-being + ecosystem well-being IUCN's egg of sustainability.

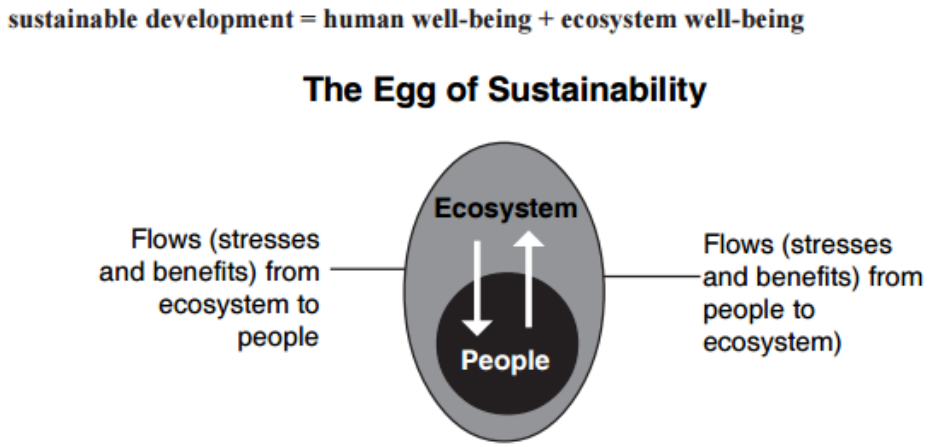


Fig. 2. The Egg of Sustainability (Source: Sustainable Development: An Introduction 2007)

Prism of Sustainability. This model was developed by the German Wuppertal Institute and defines SD with the help of four components - economy, environment, society and institution. In this model the inter-linkages such as care, access, democracy and eco-efficiency need to be looked at closely as they show the relation between the dimensions which could translate and influence policy. In each dimension of the prism, there are norms for action. Indicators are used to measure how far one has actually come in comparison to the overall vision of SD.

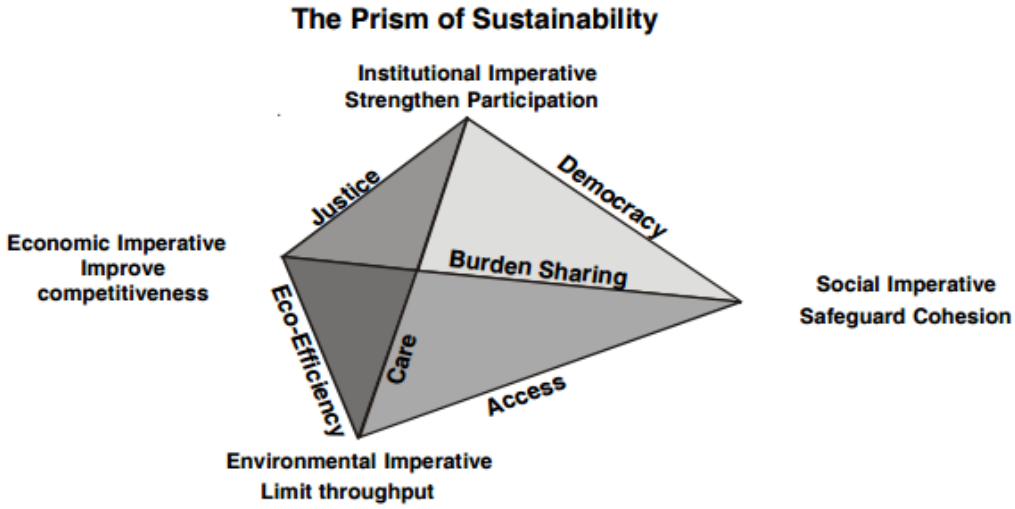


Fig. 3. The Prism of Sustainability (Source: Sustainable Development: An Introduction 2007)

Three Pillar Basic Model. This is one of the most well known models created using the three dimensions (Hak et al. 2012):

- Economy. Economic sustainability pillar involves the private motoring to work, income per capita, investment, waste recycling, current account balance, external debt, direct material input, and renewable energy resources.
- Environment. Environmental sustainability pillar involves the protected land area, use of renewable water, urban air pollution, fertilizer consumption, mammals and birds and other factors.
- Social. Social sustainability pillar involves unemployment and employment rate, Gini coefficient of income distribution, population growth rate, life expectancy, birth, and other factors related to the life of person.

The diagram shows three interlocking circles with the triangle of environmental (conservation), economic (growth), and social (equity) dimensions. Sustainable Development is modelled on these three pillars. This model is called 'three pillars' or 'three circles model'. It is based considering the society, but does not explicitly take into account 'human quality of life'.

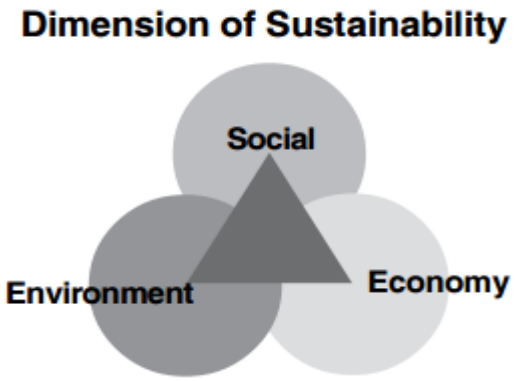


Fig. 4. Dimensions of Sustainability (Source: Sustainable Development: An Introduction 2007)

4. The scheme of national, regional development sustainability management

Searching for an answer to the question, what kind of forces (power) leads and supports the development of the region or region, is highlighting the openness of process for the internal and external factors. In addition, this process is endless, because here is the absence of evidence from which it may be said that the region is the most developed. In the scientific literature are described a number of different regional development methods, so the development should be seen as a long-term process of targeted changes, which try to manage the region‘s administration using its regional entities (companies, societies, institutions) activity, internal (endogenous) development factors and experience of other regions. This process can not be fully normalized (standardized) and the „developed region‘s“ benchmark may not be created (Domanski 2004).

Rutkauskas et al. (2011) presents the universal sustainability concept and the scheme that reveals the content of concept. These functional components for sustainable country development are secreted in the scheme:

- economic sustainability;
- social sustainability;
- ecological sustainability;
- creative sustainability;
- educative sustainability;
- religious sustainability;
- innovative sustainability;
- technological sustainability;
- investment sustainability;
- political sustainability;
- integral sustainability;
- marketing sustainability.

The universality of country’s sustainable development here is understood as the quantitive assessment of all activities results and their interactions in the country and, what is more, the direct engagement in the strategic criteria and indicators of development. At the same time, country’s general investments are considered to be as the resource of activities development, which is optimally allocated in all activities (see. Fig. 5).

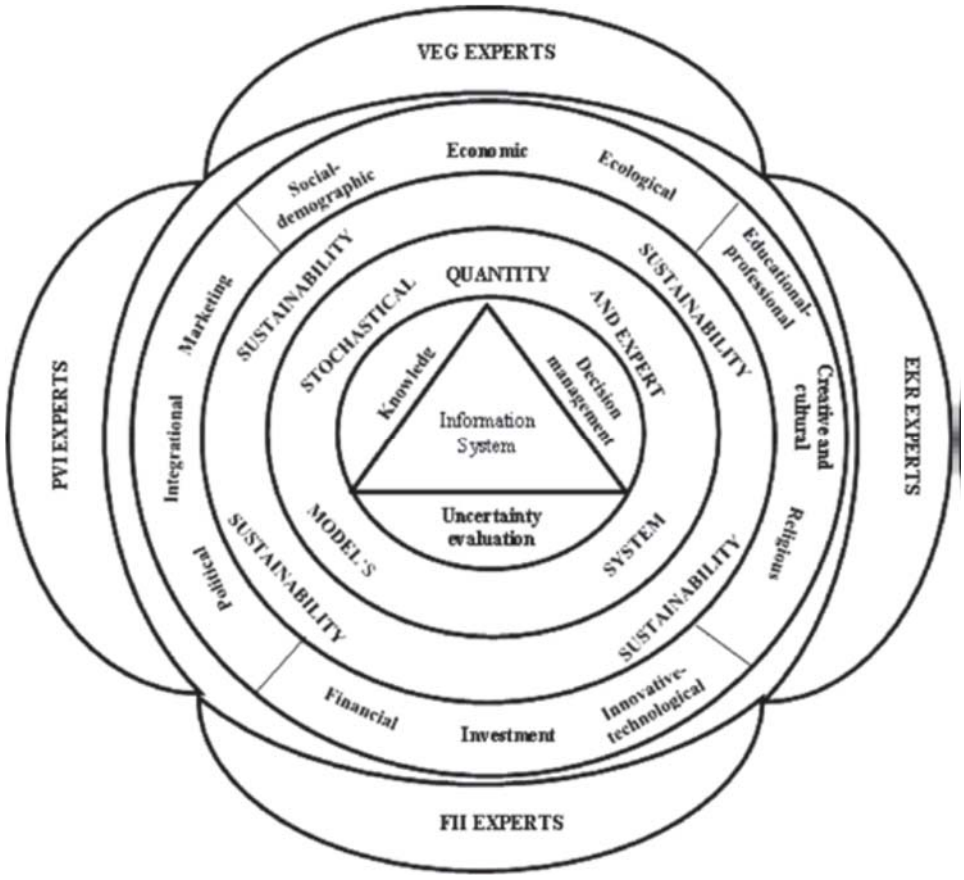


Fig. 5. Scheme depicting the development of universal sustainability components with fragments of knowledge, information and decision management systems (Source: Rutkauskas 2012)

Hereinafter the authors briefly discuss a couple of situations, where the staged results of country's activities are related to the indicators that can reveal sustainable development of the country. The dynamics of evolution indices reveals the level of country's development and progressivity of development dynamics. For this purpose, we will use stochastic network model (see. Fig. 6), which is quarried in three dimensional space: on the abscissa – efficiency, on the aplicate – reliability, on the ordinate – riskiness. From Fig. 6 we have to understand that in this case all the evaluations are carried out according to the effectiveness of possibilities, reliability of effect and riskiness. The detailed

information about the use of these ideas can be found in these works: Rutkauskas et al. 2014, Rutkauskas 2015, Buračas et al. 2014.

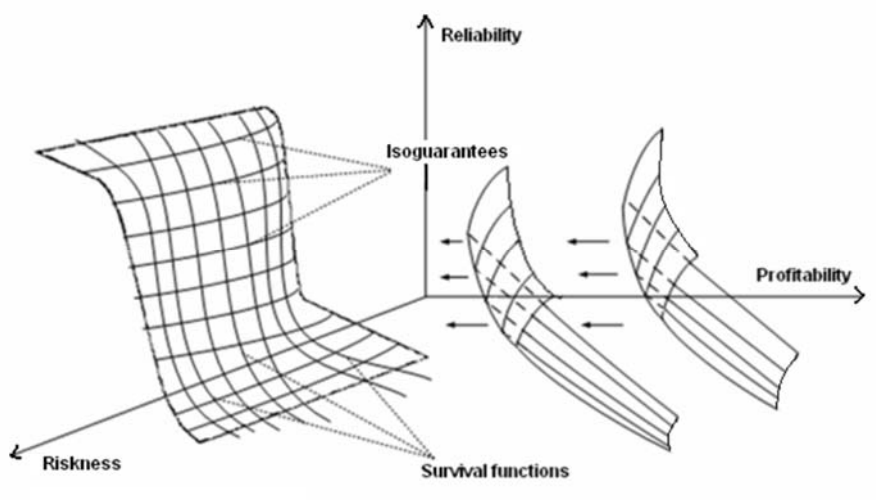


Fig. 6. The structure of stochastic network (Source: Rutkauskas 2012).

5. The allocation of investment resources according to the needs of capital accumulations

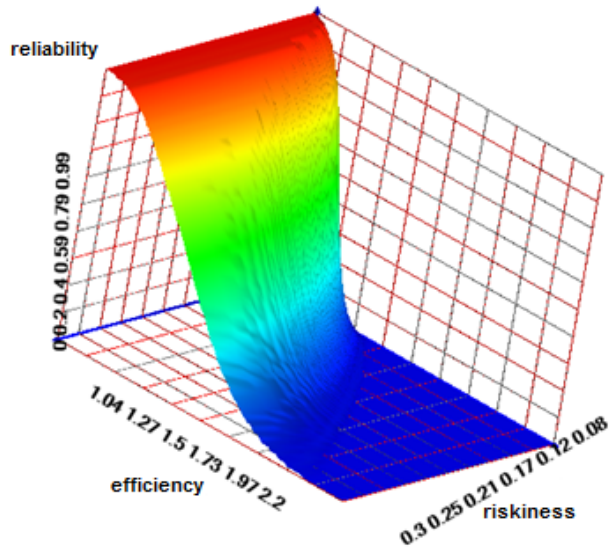
The purpose of this paragraph is to show that an exclusive focus measuring the sustainable development can be given to the sustainable development of main types of capital – financial, natural, created, human and social.

When we are talking about assurance of sustainability development, the principal moment is how to allocate the available resources according to emerging capitals or their functions. Goodwin (2003) distinguishes five types of capital - financial, natural, produced, human, and social.

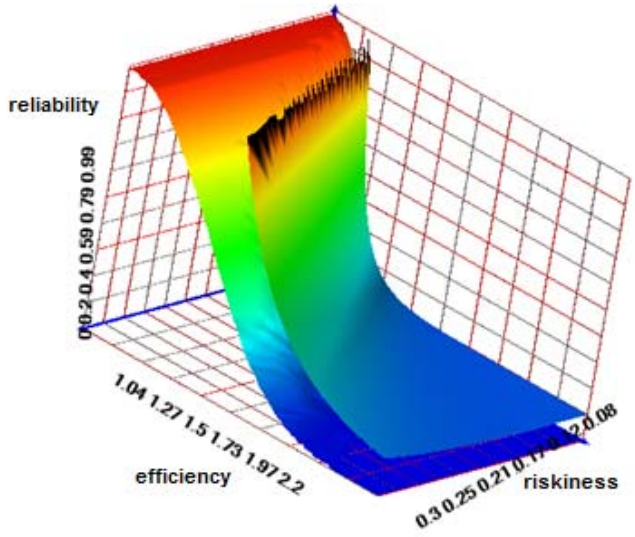
It is fully understandable that the full-scale usage of the created possibilities of every capital requires the special efforts and resources. It is possible to form one of the most important strategy chains of capital markets development – the optimal allocation of resources between five different capital types in order to achieve integrated functional efficiency of capitals.

The decision process and its results are presented in Fig. 7: the set of possible solutions is provided in A section, contiguity of the set of possibilities and utility surface – in B section, the solution – in C section, investment allocation between capitals – in D section. At the same time it should be noted that A, B, C and D sections are the decomposition of stochastic network, which is in Figure

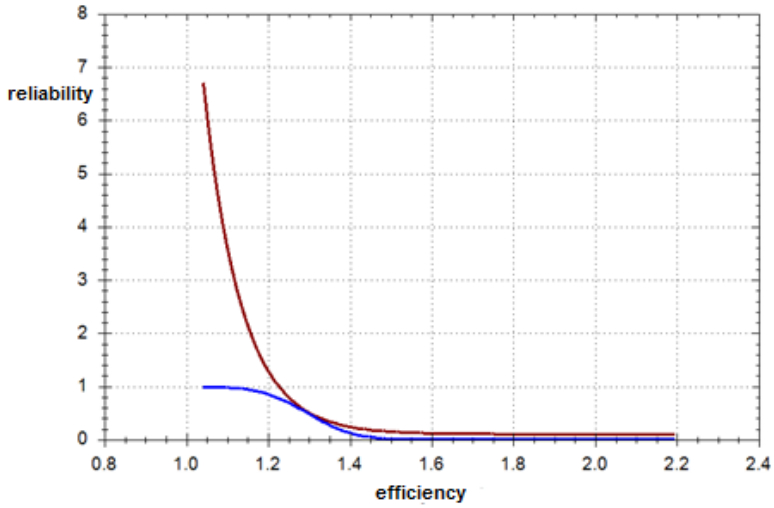
6, what shows that the assessments are made considering to the potential efficiency, reliability and riskiness.



A section. The set of possible solutions



B section. Contiguity of the set of possibilities and utility surface



C section. The solution

ω_1 **=0,19**	ω_2 **=0,18**	ω_3 **=0,18**	ω_4 **=0,23**	ω_5 **=0,22**

D section. Investment allocation between capitals

Fig. 7. Optimal allocation of investment resources between created capital volumes (Source: created by authors)

6. The possibilities nurture of country's generated added value creation

The authors try to reveal how to structure the country's economic activity that creates the best growth of added value in this paragraph.

The stochastically informative expert estimates the need for investment capital of every created marginal unit, which was used in five capital model as model inputs. In this case we will use only reporting stochastic data. The detailed annual and quarterly statistical data of economic activities results is in the statistical database of Lithuanian Statistical Department. They can be used in order to uncover regression dependencies between the created added value and

usable investment in every concerned activities. It was rated, how marginal investment unit should be divided between 11 activities in order to ensure the results that promise the highest gross value added, aggregating all economic activity into 11 economic activities and using stochastic network model. Below is a list with separate activities and the proposed investment unit ω_i, i =1, ..,11, for each activity:

1. agriculture, forestry and fishing - ω_1=0,08;
2. industry, except energy - ω_2=0,09;
3. energetics - ω_3=0,08;
4. construction - ω_4=0,08;
5. wholesale and retail trade, transportation - ω_5=0,09;
6. information and communication - ω_6=0,10;
7. financial and insurance activity - ω_7=0,09;
8. real estate transactions - ω_8=0,08;
9. professional, technical and scientific activity, administrative activity - ω_9=0,11;
10. public administration and defence, education and health - ω_{10}=0,10;
11. arts, entertainment and recreation organization - ω_{11}=0,07.

The article's assessments and the use of proposed principles and techniques, significantly limite inadequate statistical-sized accounts, particularly the attempts to understand the uncertainty and risk impact and consequences. Lack of expertise and stochastically informative diversity. The paper proposed the development of sustainability measurement and management in view of the uncertainty of the influence of principles and techniques would be useful in a variety of social and territorial systems of sustainable development opportunities disclosures.

7. Conclusions

The development sustainability science of country or region, which is formatting in the intersection of economics and management sciences, has taken attention to the separate development opportunities preservation of country or region. This is actual not only in the country or region level, but also in terms of diversity conservation of demographic, political and public management. The loss of thos diversity for civilization development can be dangerous as the loss of biological diversity for all natural environment.

Particularly intensively exploited concept of sustainability of system condi-

tion or development, which formed the large creation power and is oriented to racional use of development resources.

The adequate quantitative description of the analysed processes and their interactions should be used for strengthening of above mentioned trends and for the implementation of objectives. Particular emphasis should be given to the disclosure and implementation of optimal solutions under conditions of uncertainty, according to that were marked a significant development opportunities as a whole.

It is useful to give a sence for this indicators as the indicators of country's development, fully disclosuring their links with the recovered investment resources under conditions of analytical studies and quantitative assessments of human, produced, natural, social and financial capital. In this case, the indicators system is formed ant its development becomes the direct strategic objective of country's development.

The article's assessments and the use of proposed principles and methods, significantly limite inadequate statistical-sized accounts, particularly the attempts to understand the uncertainty and risk impact and consequences. Also insufficient diversity of stochastically informative expertise.

The paper proposed the principles and techniques of development sustainability measurement and management, considering to the influence of uncertainty that should be useful in a various disclosures of the development sustainability opportunities of social and territorial systems.

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