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INTEGRAL KNOWLEDGE, INNOVATION AND TECHNOLOGY CLUSTER FORMATION NURTURING THE UNIVERSAL DEVELOPMENT SUSTAINABILITY IN THE CONTEXT OF GLOBALIZATION

ABSTRACT. *Purpose* – the main objective of this paper is to reveal the positive interaction of regional economy, the universal sustainable development and integral cluster of knowledge, innovation and technologies in the context of globalization processes, when the management of uncertainty and risk becomes the extremely important component for the successful realization of the country's development strategic decisions.
Design/methodology/approach – this paper examines a particular strategy of universally sustainable development of small country, when the main search instrument and implementation technology of universally sustainable development is the integral cluster of knowledge, innovation and technologies.
Findings and Originality – this paper presents the original concept of integral cluster of knowledge, innovation and technologies and formulates the concept and principles of optimization of integral cluster valued structure. Experimental approaches of investment strategy formation for universal sustainability of country development is made for the Republic of Lithuania.

JEL Classification: M2, L1, F6, D8

Keywords: globalization; innovation and technologies; intelligent investment; integral cluster; knowledge uncertainty and risk; universal development sustainability.

Introduction

Sustainable development and purposeful integration of science, innovation and technologies are the main instruments that would help the world to overcome the current and potential future challenges. The rapidly progressing globalization and the existing need for national sustainable development are the main drivers for the continuous integration of knowledge, innovation and technology. However, the current analyses of sustainable development lack quantitative measures and accordingly unified concept and expression of sustainability as well as theoretically perfect and pragmatically active perception of knowledge, innovation and technology integration that would foster the sustainability of various systems and processes.

An in-depth analysis of the United Nations Post-2015 UN development agenda suggests that global economic growth and growth potential of an individual region or country as well as solutions to such global problems – food shortage, health and growth of ecological unsustainability – can be successful only through purposeful development of knowledge, innovation and technology (further – KNIT) cluster. Considering possible global and space disasters, there is no other alternative for the purposeful development of scientific knowledge and space technologies.

The future „Europe for Citizens" program for 2014-2020 (EU Future Program 2014-2020) treats the future challenges and possible ways to avoid the consequences in a rather similar manner. As well as the UN Post – 2015 Development Agenda, it strongly speaks for the shift of scientific research from interdisciplinary knowledge to problem-centered researches.

Both aforementioned programs and a number of other UN and EU documents very responsibly describe the development policies and priorities, potential problems and their solutions as well as discuss local and global challenges. Almost each of them suggests a unified approach to sustainability of development as reasonably most beneficial way forward. Hence, the structure of an integrated KNIT cluster not only appears to be adequate but is also the most effective way to achieve sustainable development.

The following relevant issues, which were carefully touched upon should be distinguished among numerous planned scientific research and pragmatic KNIT structure improvement projects:

- what is the compatibility of limitless economic and demographic growth with the limited possibilities of the planet Earth?
- what are practically unmanageable or even artificially promoted negative consequences of globalization, could they ruin all benefits provided by globalization?
- what should be the concept and models for quantitative measurement of sustainable condition or development pertaining to the process or system?
- what are the mechanisms of KNIT cluster optimal structure formation?
- what forms of integration and communication between different states should dominate in the period of post globalization?

There is no doubt that these are the most complex global political issues that could be efficiently addressed designing a KNIT cluster, which would integrate knowledge, innovation and technology considering a variety of internal/external factors (social, cultural, economic, political, innovation and etc.). The design of such cluster concept and alignment of functions pertaining to its components – knowledge, innovation and technology – allows understanding the basic principles behind the sustainable development of country that fosters intelligent investing. The finalized research on intelligent investing possibilities gives rise to reasonable consideration of the use of KNIT cluster potential for national sustainable development.

The first chapter of the paper is intended for the formation of integral KNIT cluster concept; second and third chapters describe its application while nurturing the universal development sustainability.

1. Integral knowledge, innovation and technology cluster as a self-regulating complex system

In the scientific literature and pragmatic summaries, it is hardly possible to detect a more detailed interpretation of the progress of interaction between science, knowledge, innovation and technology aimed at sustainable development and the form of interaction between development and integrated KNIT cluster.

Realizing that the integral KNIT cluster base is the human intellect, the transformation of the cluster into the self-organizing system does not cause any bigger surprise. But how KNIT cluster accumulates the potential of development factor while the cluster mainly is composed of heterogeneous elements, i.e. oriented towards the implementation of different functions, remains an open question. And yet, we can say that untouchable question remains as to whether the integrated structure of KNIT cluster, adequate in particular situations, has been selected in the past for the cognition and implementation of development possibilities. A confrontation with the past must achieve greater attention both for understanding the development sustainability effect and integrated KNIT cluster possibilities to increase this effect.

The complexity of integrated KNIT cluster structure and its changes is associated with the complexity of process or system selected for testing. There is no doubt that understanding of the KNIT cluster structure for such sophisticated processes as regional or national development is not only significant but also requires high-level scientific efforts. The object of this research is the analysis of KNIT cluster structure pursuing sustainability of development in a particular country.

1.1. The key assumption for purposeful development of knowledge, innovation and technology clusters

The development of subsystems of knowledge, innovation and technologies and what is more the perspective of its integral network – these are the most complex, and thereby the most actual problems for human being and the perception on them may reveal which ways of development are acceptable and practically realizable, which strategies of humanity or individual countries are survival strategies and the guarantee of success. And it becomes clear when the generation of fundamental scientific knowledge is associated with the creation of the universe and the phenomenon of creation, assuming the fact that time for human existence on earth may not be enough to understand it. It is important to note that the codes of physical, biological, spatial and other regularities and management possibilities can be considered only as conditional.

Maybe it would be easier to know more about human origin and the way and conformity of human society evolution in nowadays society and thus their management possibilities. However, this should not be a limitless source of optimism. The ability to intervene in human genetics and social development threatens us with the destruction of the main value of human nature. And such tests do not disappear, they are becoming more intensive.

In fact, science is intensively interested in the evolution of human cognition, including the complex physical and cosmic processes and substances. This provides hope of pragmatic understanding.

In this paper we will try to discuss the need of knowledge, innovation and technology cluster development and assumptions when science declared sustainable development possibility guarantees should be implemented in time-limited perspective (§ 2.1.), as well as intelligent investment strategies for the implementation of universally sustainable development strategy in a particular country (§ 2.2).

1.2. The value of clustering of knowledge, innovation and technologies

Currently there is active integration of knowledge, innovation and technologies, and the growth of knowledge need and importance promotes the occurrence of specialized multidimensional cluster of knowledge, innovation and technologies. In this article, the cluster is considered as a whole of the interconnected multiple subsystems (knowledge,

innovation and technologies), that has a general object of cognition (Rutkauskas *et al.*, 2013). The essence of such cluster – to create the general system of existing and acquired knowledge, evolving innovations and technologies, which would create a base to manage properly the object, fostering its state and sustainable development.

The base of intelligence of multidimensional cluster is knowledge as a key resource that promotes the ability to create unique and even in fuzzy environment.

In the context of globalization, the essence of knowledge management, as a valid tool for the improvement of activity efficiency, is based on the fact that in order to maintain the uniqueness, which could not be imitated by other organizations so fast, it is no longer sufficient to manage traditional resources. Knowledge has to focus on the management of essential and exclusive competencies and organizations must be above the current level of knowledge and be able to create the new knowledge at the lowest costs.

How to manage the current knowledge efficiently and to acquire the new one with the minimal costs having limited resources – these kind of problems are examined systematically and are implemented through the processed model of knowledge management, which creates the cycle of processes and forms the chain of knowledge value creation.

Knowledge by the scientists is defined ambiguously and treated in various positions of the sciences (psychology, management, information etc.) (Wiig *et al.*, 1997; Becerra-Fernandez *et al.*, 2004; Chen *et al.*, 2005; Atkočiūnienė, 2006; Probst *et al.*, 2006; Mikalauskienė *et al.*, 2007; Fong *et al.*, 2009; Frenz *et al.*, 2009; Boehm *et al.*, 2010; Ertmer *et al.*, 2010; Hawryszkiewycz, 2010; Luke *et al.*, 2010; Steyn *et al.*, 2010; Fakhri *et al.*, 2011; Sullivan *et al.*, 2011; Fletcher *et al.*, 2012; Pacharapha *et al.*, 2012; Raudeliūnienė, 2012; Sakalas, 2012; Glucker, 2013; Rutkauskas *et al.*, 2013).

By the levels, knowledge can be classified into: individual, group, organization, sector, state, regional and others. Individual and organizational knowledge can be distinguished according to the holder of the knowledge. Individual knowledge – it is a person‘s knowledge controlled depending on the individual and not necessarily related to the specific content. Organizational knowledge is related to the specific content.

Summarizing various scientific opinions, knowledge can be described as related to individuals, their processes of cognition, as dynamically changing depending on changes of the cognition structure also like a motive (assumption) to operate. Individual‘s knowledge is used as a base for data to become information (data are input and information – output) and to create greater value solving problems, formulating, assessing, adopting, implementing decisions.

Knowledge is also, treated as the organizational resource, corresponding to the principles of the resources management: produced at the right time and in appropriate form, available in the right place, fulfilling the quality requirement, created with the lowest costs.

However, the researchers note that knowledge has a certain advantages compared with other organization‘s resources: it is intangible and hard to measure, characterized by the volatility; is not „consumed“, knowledge quantity increases by its applying; it can not be purchased at any time in the market, often have to wait for the results; can be used simultaneously in different processes (Wiig *et al.*, 1997).

This uniqueness of knowledge is determined by these circumstances of that knowledge is a substance when the nurtured process is not already associated with the energy required for realization of action and here may be examined the widest range of possibilities (Bjørnson *et al.*, 2008; Antonelli, 2009; Al-Jedaiah, 2010; Sullivan *et al.*, 2011). Knowledge is seen as the ability to perform the specialized tasks and as a way or experience of communication (i. e. through the prism of skills and experience), so it is appropriate to accumulate new knowledge improving acquired skills and deepening the experience (Fakhri *et al.*, 2011; Pacharapha *et al.*, 2012). Information is an invisible asset which is considered to be an essential resource in the value creation. Proper management of information increases

the acquirement of the knowledge about the organizations and clients and business uniqueness. Therefore, researchers distinguish the need to combine tacit and explicit knowledge (de Noronha Vaz *et al.*, 2009; Camic *et al.*, 2012; Devece, 2013; Gluckler, 2013) and in this base to create a unified system, where the necessary information would be saved and which could be specified and shared at any moment.

Improperly managed knowledge loses its value faster than material resources, so the current knowledge must be used in the most efficient way. Decreasing the knowledge demand by increasing the knowledge supply arise the possibilities to use more advanced technologies and foster innovations in business processes (Friedrich *et al.*, 2009; Luke *et al.*, 2010; Vargas-Hernandez *et al.*, 2011). As a result the fostering of successful technology application, making the attention to such key factors as: asset, knowledge, skills and organizational processes became especially important factor after the widespread use of IT in the organizations activity processes The integration of knowledge and technologies appears in the base of interaction and analysis of these aspects, and it promotes not only the search and application of more improved management methods, but also the changes of organizational business structure or more detailed presentation of industrial characteristics.

From the concept of analyzed assessment aspects innovations, especially technological innovations become one of the essential uniqueness factors promoting the emergence of new technological achievements developing the skills and knowledge (Todtling *et al.*, 2009; Bastalich, 2010; Fakhri *et al.*, 2011; Silva *et al.*, 2013). Technological innovation occurs at the junction of the technologies and innovations, when the application of technologies in the business area becomes more and more important at the cost-effectively evolving world. This kind of innovation is seen as essential uniqueness factor for the emergence of new technological achievements and creates the possibility for a return developing the skills and knowledge.

Innovations promote the interactive process of the generation and application of new knowledge. Using innovations, the companies better meet the consumer needs, increase the operational efficiency, improve the product quality, reduce the project life cycle and as a result improve their position in the market. The results from the analysis of internal and external factors can be used for the targeted fostering of innovations and their application in several ways. In the broadest sense, innovations can be applied in four ways (Huang *et al.*, 2009; Savaya *et al.*, 2009; Goel *et al.*, 2012; Alam *et al.*, 2013): statically (transferring the existing knowledge); dynamically (learning collectively); formally (according to the rules and regulations); informally (communication ways).

Consequently, the development of innovations and technologies highlights the need for necessary missing knowledge, therefore knowledge, innovations and technologies constantly interacts and within the interaction limits forms the multidimensional cluster, which creates the assumptions to foster the country‘s universally sustainable development, when a specific attention is focused on the versatile knowledge development.

2. Integrated management of the intelligence and knowledge, innovation and technologies, developing the investment strategies, fostering the sustainable development of the country’s universally sustainable development

Already a historically significant can be called the period of time, when the progress of knowledge, innovation and technologies is called as the key factors in enhancing business efficiency and raising its sustainability and coherence. Especially actively develops the identification of KNIT cluster functional possibilities solving the social, economic and general problems of sustainable development. The cognition of anatomy and self-organizing patterns of integral KNIT cluster requires special efforts. However, assuming the real circumstances that

KNIT cluster becomes perhaps the only available resource solving the important social issues, the disclosure of KNIT cluster's value structure – the problem that must be solved urgently.

2.1. The principles and planning opportunities of financial resources for country's universally sustainable development

In this study, do not digressing from the analysis of business development sustainability, we will focus more on the development sustainability of economically, politically and territorially independent country, when scientific knowledge, the progress of innovations and technologies becomes the key resources forming or directly influencing the named development factors. The special attention here, of course, is given to the business sustainability, but in parallel will be considered in full-rate the development of the public sector, educational systems and scientific validity of other solutions.

Achievement of these objectives will require the use of adequate methodology, concretizing the model of country's universally sustainable development, also developing the coherences of knowledge concept with surrounding categories, facts, information, intelligence and wisdom (Rutkauskas, 2012; Rutkauskas *et al.*, 2013). Visually it is presented in *Figure 1 – 3*.

Figure 1 presents the external subsystems, representing three components of development, band of experts blocks appeals to the need of round table quantitative discussion, determining the balance of various development parameters. *Fig. 2* illustrates the scheme for knowledge generation, design of the national universally sustainable development strategy and functional innovation and technology integration into strategy implementation.

Fig. 3 is a short digest of 12 components required for national development with their aggregation into 4 subsystems with such abbreviations: political-integral-management and marketing (PTV), social (demographic)-economic-ecological (SEE), educational/qualifying/professional-creative/cultural (EKR) and financial-investment-innovative/technological (FII).

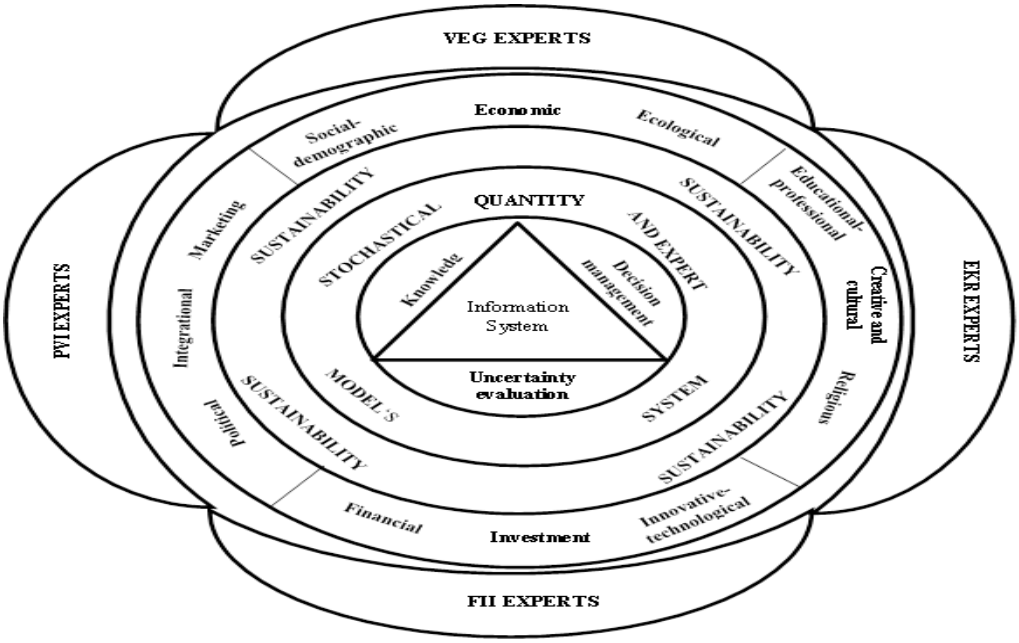


Figure 1. The formation of the important components of development sustainability and the preparation of knowledge and tools of expert evaluation, nurturing the possibilities of development sustainability and the round table idea
Source: Rutkauskas, 2012.

Figure 1 presents both the concept of study between the subsystems and the whole of tools for formulation of solutions and searching them: the systems of information knowledge, solution management, uncertainty assessment and similar and the stochastic models of quantitative solutions and expert evaluation. However, we need to admit the evaluation of individual problems, when stored and generated information helps to search for the compatibility between the different aspects of development and so-called stochastic informative expertize methods are invoked for expert evaluation. When the country's development system is analyzed or projected, the experts indicate that the system is focused on the creation of the possibilities for the quantitative interview. This means that information about the emerging problems and changes at any subsystem or component is sent to other subsystems, which in turn demonstrates its own reaction.

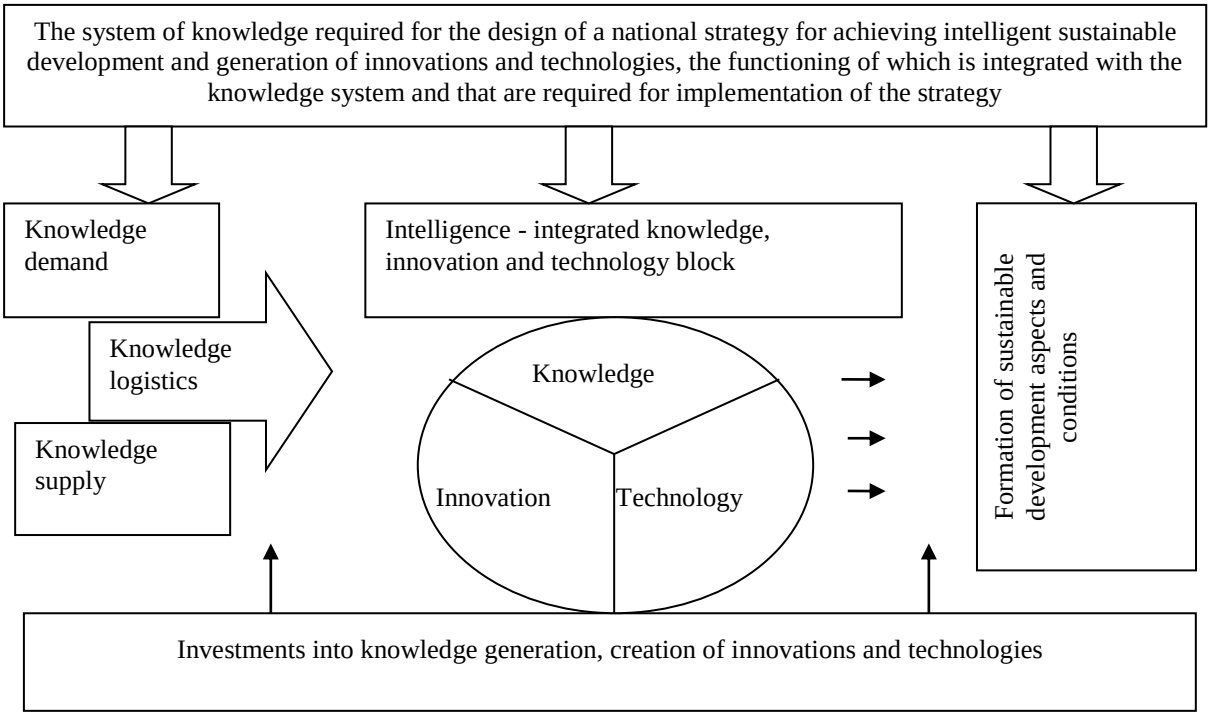


Figure 2. The system of knowledge required for the design of a national strategy for achieving intelligent sustainable development and generation of innovations and technologies, the functioning of which is integrated with the knowledge system and that are required for implementation of the strategy
Source: Rutkauskas *et al.*, 2013.

INTELLIGENT INVESTMENT STRATEGIES										
Political sustainability	Integrational sustainability	Marketing sustainability	Social-demographic sustainability	Economic sustainability	Ecological sustainability	Educational-professional sustainability	Creative and cultural sustainability	Religious sustainability	Innovative-technological sustainability	Financial sustainability
PIV			**SEE**			**EKR**			**FII**	

Figure 3. Subsystems of the national universally sustainable development
Source: Rutkauskas *et al.*, 2013.

We will further present the definitions of each component (Rutkauskas, 2012), seeking for the interest of country's development factors and its activity existence:

- *Religious sustainability* – it's a humanity possibility to accept the temporary existence on earth and the indefinite existence in another world, recognition of spiritual values, avoidance of religious hostility and everyone's exclusive focusing on problems of weaker and unhappier member of the society.
- *Political sustainability* – it is an opportunity to ensure the country's democratic political institutions regeneration, which can guarantee the representation of public interest and also to the country's representation in international bodies.
- *Social-demographic sustainability* – the ability to reconcile harmoniously the different interests of various social groups, ensuring appropriate human existence conditions in every hierarchical level, and what is most important – the ability to understand the evolution of society, based on scientifically recognized regularities.
- *Economic sustainability* – it is a consequence of ability for a rational use of both internal and attracted resources from the country's while ensuring sustainable growth of the created economic results.
- *Ecological sustainability* – is usually associated with the ability to maintain the diversity of biological systems and the effectiveness of their country.
- *Educational – professional – creative sustainability* – the ability to combine learning, professional education and creativity developing business analytics, creative industries development and domination of creativity, the knowledge economy, which ensures the supply and demand balance in the labor market.
- *Creative and cultural sustainability* – the ability to create something new, having a value through intellect.
- *Innovative – technological sustainability* – the ability to ensure the use of the most advanced technology, based on the most efficient innovations, in products and services.
- *Integration sustainability* – it is insightful integration of the country into the local, regional or global institutions of general or economic security with reasonable costs for the country.

- *Marketing sustainability* – it is the utilization of the country's marketing power in a way which ensures the sustainable export-import traffic, benefits from improved performance development.
- *Financial sustainability* – the power of financial system that ensures the necessary financial resources for the country's businesses, the public sector and the international commitments.
- *Investment sustainability* – the ability to generate investment strategies that mobilize the country's business, the public sector and society and there are offered techniques and methods to invest in such a way that future generation would have the opportunity to fulfil their objectives.

The illustration of experimental situation, optimizing the allocation of resources

If it is assumed that the sustainability of the country development can be examined through a model of complex system we have to admit in advance that in the actual reality the entirety of existing elements as a rule is characterized by the following features:

- ✓ a very complex structure;
- ✓ high sensitivity to even small changes of dependencies between the individual components;
- ✓ it is difficult to identify and verify it even if its design or the function, or both of these moments are known;
- ✓ it is characterized by the abundance of interactions between different components;
- ✓ the new features or even states may reveal through time.

It is no doubt that all of these characteristics are common to the country's sustainable development phenomenon. However, if it is also required to be an open self-regulating system, which functional purpose requires resources, which becoming the input elements can lead not only to the changes in the internal dependencies, but also to the effect created by the individual subsystems, and the system itself we need to agree that the systems, which contain the above mentioned features, also require the creation of adequate opportunities for the system cognition and management.

A separate challenge is the examination of sustainable development problems in the context of complex systems methodology, where appears the question concerning the alignment of efficiency measurement dimensions of separate subsystems and overall system. It is worth noting that sustainability measurement is associated with two-dimensional dimension – the efficiency and reliability. Reliability has nondimensional measurement method; therefore – measuring the efficiency the indicators, representing the content of subsystems or all system existence (created product, the crop and so on) become very important.

It is true that in complex systems there are the possibilities that one subsystem's state may be the factor of another subsystem's state when difficult separate subsystems indicator's function can be the final indicator of overall system. However, the most difficult problems arise when we need to solve the main economic problem – how to allocate rationally the scarce resources with the purpose to orient system movement into optimal state or trajectory.

Further, assume that we can measure each subsystem's state, with nondimensional indicator and we can determine the marginal efficiency of the unit using an informative expert valuation, if it is used to develop the i-subsystem functionality. Then we can form a task – how to find the optimal resource allocation among subsystems in conditions of uncertainty.

Let's suppose that the expert evaluation shows that the marginal investment unit utilization, observing certain investment proportions between isolated subsystems and

subsystems formed inside, opportunities to change state of each subsystems index (which will take equal to one unit) can increase (decrease) the following stochastic multipliers:

$$D_1(a_1, S_1),\ D_2(a_2, S_2),\ D_3(a_3, S_3),\ D_4(a_4, S_4),$$

Where a_i, S_i – are mean and standard deviations of respective random variables.

Let's try to determine under what proportion we can divide marginal investment between the abstracted subsystems, if the system status indicator - I is formed as geometric averages of a product of subsystems indicators I_i: $I = (I_1 \times I_2 \times I_3 \times I_4)^{0.25}$.

Let us consider two cases:

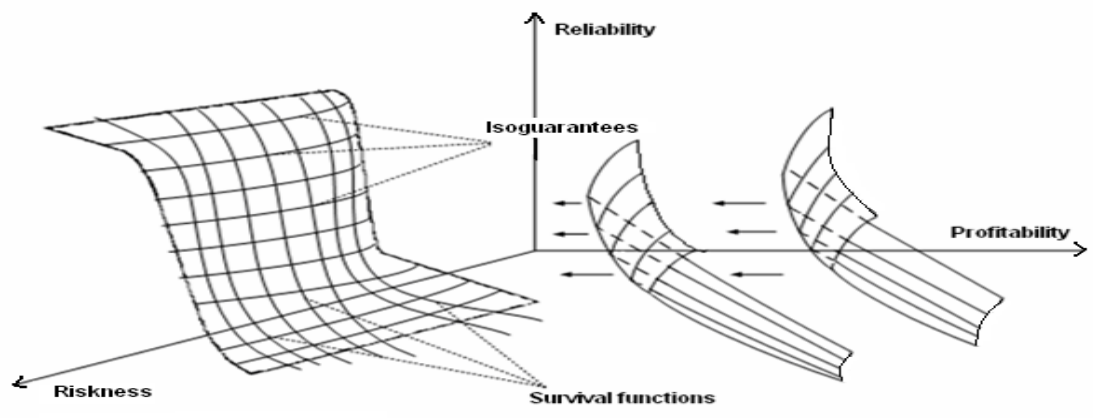
1. When we accept that mentioned multipliers are normal random variables;
2. When the situation is complicated and mentioned multipliers take on specific-typical forms for these subsystems.

D_1 – becomes lognormal, D_2 – becomes Gumbel distribution, D_3 – Laplace distribution and D_4 – becomes normal.

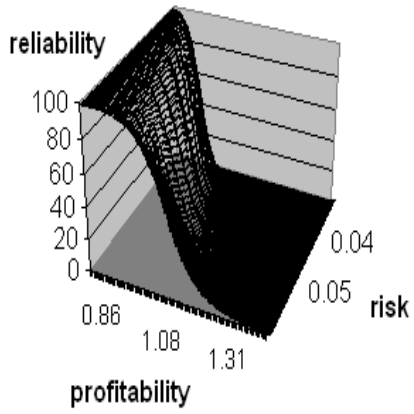
In both cases the distributions are governed by the following averages and standard deviations:

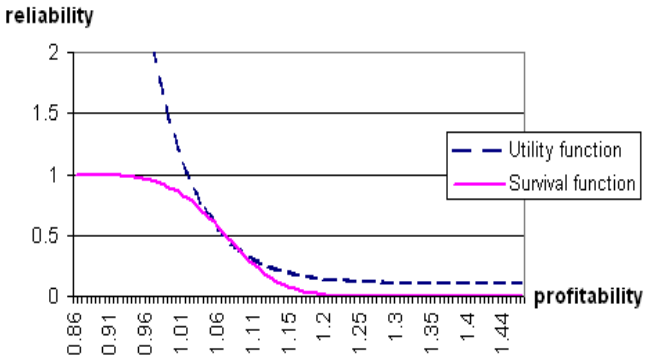
$$a_1 = 0{,}94;\ s_1 = 0{,}03;\ a_2 = 1{,}22,\ s_2 = 0{,}06;\ a_3 = 0{,}99,\ s_3 = 0{,}05;\ a_4 = 0{,}90,\ s_4 = 0{,}02.$$

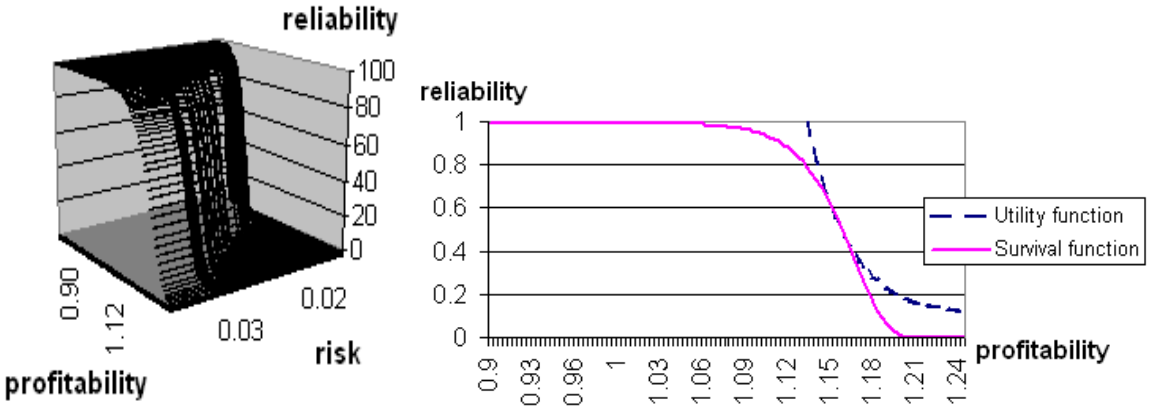
Results are presented in *Figure 4*, they are obtained by means of adequate investment portfolio logic and technique (Rutkauskas, 2006).



a section







b section

1 case				2 case			
1 active	2 active	3 active	4 active	1 active	2 active	3 active	4 active
The normal probability distribution				Gumbel distribution	La Place distribution	Normal distribution	Lognormal distribution
0.38	0.08	0.28	0.26	0.26	0.32	0.2	0.22
Parameters: *e*=1,073116 *p*=0,87 *r*=0,013701				Parameters: *e*=1,151202 *p*=0,77 *r*=0,029649			

c section

Figure 4. Optimal allocation of resources among four subsystems: a section – the general view of three-dimensional efficient surface and respective utility functions; b section on the left – possible solutions surfaces, on the right side – the particular decision finding; c section – detailed decisions.

The results have to be recognized just as original ones because of the lack of expert evaluation experience in such difficult situations as well as the lack of experience determining the adequacy of experimental utility functions in similar situations.

2.2. Allocation of financial resources in order to attain effective integration of knowledge, innovation and technology

Moving from the possibility analysis of financial resources allocation, when focusing on the necessity of the country's sustainable development to actual allocation of financial resources, pursuing an effective integration of knowledge, innovation and technology, we will discuss the most important functions of main development factor components.

✓ Knowledge – a resource that is naturally emerging, human created, continuously updated and necessary for:

- developing a full understanding of what is happening in the surrounding environment;
- to clusterize techniques as measures of performance to ensure human survival and continuity;
- fostering innovation that can guarantee sustainable development.

✓ The knowledge generating process, as the means of complete understanding, seems to be a process that is easiest understood and least influenced by subjective interest.

However, adequate knowledge generation remains a major integrated KNIT cluster efficiency prerequisite, considering that inadequate knowledge can generate insightful technologies.

- ✓ Knowledge clusterization into activity technologies includes abundant material and financial resource integration. In turn clusters of technological knowledge combine knowledge of different nature and direction. Besides, different interest groups participate subjectively in the use of technology. Therefore, the unwary formation of technology can create considerable loss not only to an individual entity, but also to the whole activity, country or region.
- ✓ Innovation system is defined as a network of private and public institutions whose activities and interactions initiate, import, modify and insert technologies.

As mentioned in the introduction of the article, we describe experiments finding the optimal allocation of resources, forming an integrated knowledge, innovation and technology cluster in order to achieve universally sustainable development in Lithuania.

Trying to identify and generate the knowledge directly, implement technologies and cherish innovations for longer perspective would require the analysis of quite debatable problems. Therefore, as a rather simplified scheme for solution of mentioned problem, we will use the model structure of innovative functions of the system submitted by Rutkauskas (Rutkauskas, 2006; Rutkauskas *et al.*, 2013) and here reformatted for opportunities analysis of universally sustainable development used stochastically informative expertise principles for the optimal allocation of financial resources among four integrated components of universal sustainable development. Early results of the assessment are provided in the *Table 1*.

Table 1. The optimal allocation of financial resources between KNIT cluster components: knowledge, innovation and technology

Abbreviation of a subsystem			
PIV	SEE	EKR	FII
Share per unit of subsystem			
0,31	0,19	0,26	0,24
e=1,1007	p=0,56	r= 0,331	

Source: created by authors.

The received assessment of solution should be linked to the evaluation of the solution in *Figure 4*. Yet the evaluations of completely different groups of experts and the use of almost identical utility functions allows to state that given subsystems requires the analogic ranged attention both allocating the general investment resources and developing the power of KNIT cluster.

3. The possibilities of adequate portfolio utility and the need for development reaching its further universality

Begining with the first presentation of adequate portfolio at international conference in Dublin („Macromodels 99“), it was presented with its application of possibilities for the rational (usually optimal) distribution of resources (usually investment) between the development components under possibilities of uncertainty and risk in these analyzed situations.

The application of adequate investment portfolio for one of the major problems of economic science and practice – for rational (optimal) use of development resources in quite

different conditions and quite different possibilities of various risk occurrences required the preparation of original models and the creation of its solution methods.

This study will consider another case of adequate portfolio use, where the main objective is pursued with the lowest costs and when the goal is the guarantee of the pursued result. Thus this chapter can be treated as a component part of chapter 2, and it will present the solution of other economic development task using KNIT cluster.

Let us consider the situation which can be identified as the service of the debt. Suppose, the borrower wants to borrow a certain amount, let's say the unit. It is possible to borrow from four sources, paying the different interests for each. Suppose, that the repayment of the debt for each lender can be described at 2.1 p. experimental version of the marginal unit where the rates of full return, where N – normal distribution with a specified average and standard deviation: N (0,94; 0,03), N (1,22; 0,06), N (0,99; 0,05), N (0,9; 0,02).

You have to remember that the situation in this study is analyzed under uncertainty conditions and designing the possibility transformation it is necessary to take into account the transformation guarantee.

If you analyze the logic of the creation of efficient possibilities surface (see *Figure 4*), you will be able to see that efficient surface can be transformed (see *Figure 6*) to its complement, which remains as the net of isoguarantees and distribution functions.

Due to simple formation of the efficient surface annex, where were only the survival function $P_x = P\{\xi \geq x\}$ changed into distribution function $\hat{P}_x = P\{\xi < x\}$, we understand the simplicity of the use of its possibilities.

Kind of intrigue becomes the selection of the utility functions for the potential possibilities in the annex. Here the utility function should be like the following phenomenon:

$$U = u\left(\frac{\hat{P}_x}{x\hat{r}_x}\right), \qquad (1)$$

where $\hat{P}_x = 1 - P_x$, and $\hat{r}_x$ is the level of risk of the distribution function, where appears the investment volume value itself. However, a really delicate issue is to select an adequate analytical (1) value of function of the three mentioned factors. In the context of an adequate investment portfolio this type

$$U = u\left(\frac{x \times P_x}{r_x}\right)$$

utility function revealed its vitality , used even simply interpreted its form:

$$U = \frac{x \times P_x}{r_x}$$

Comparing (*Figure 5*) the complement of efficient surface with the most efficient surface, we can see that in the role of isoguarantees we find the distribution function. The distribution functions perform the role of the survival functions and the complement of the most efficient surface becomes the net of isoguarantees $\hat{P}_x$ and the distribution functions.

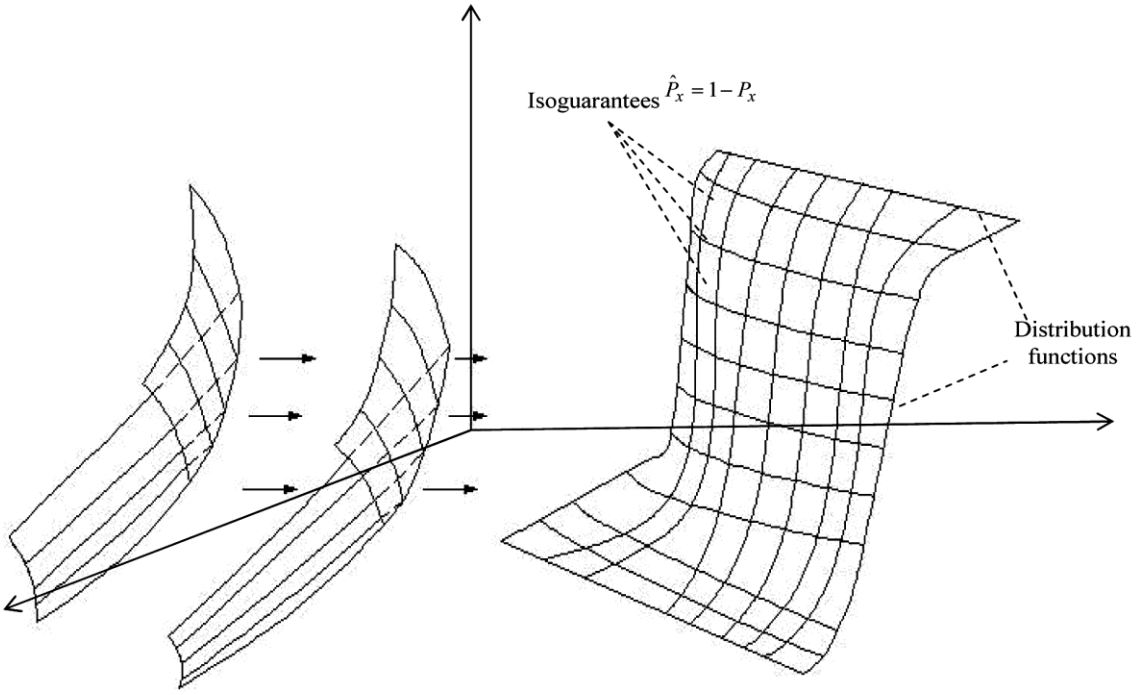
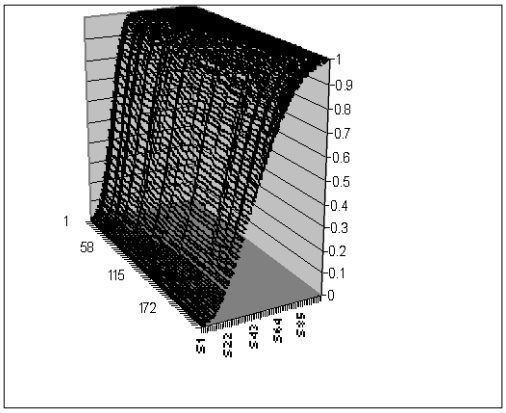


Figure 5. The general view of the complement of efficient surface

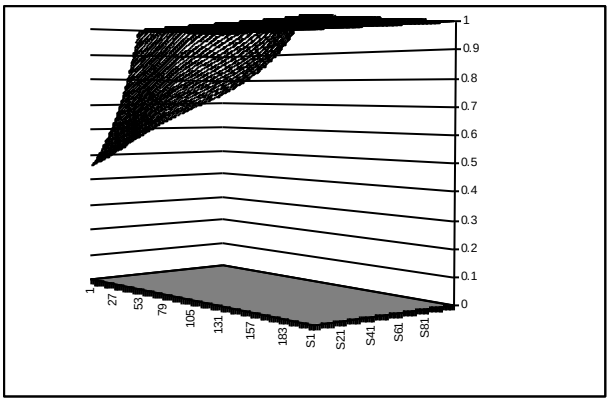
Therefore, we will present the fragments of the demonstrational stand of the complement of adequate investment portfolio at the time of decision making, i.e. when the surface of three-dimensional utility function touches the efficient surface (*Figure 6*).



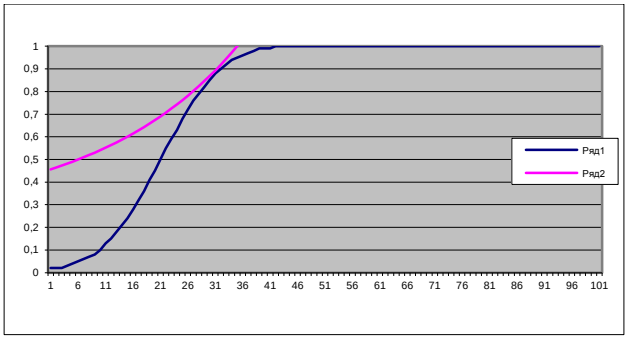
a. Efficient surface of the possibilities of complement

1	0.08
2	0.12
3	0.62
4	0.18

d. Structure, how was used the investment resources, setting



b. Three-dimensional utility function



c. Efficient surface and utility function interaction setting

1.213	1.214	1.215
0.88	0.9	0.92
0.88	0.9	0.92
0.88	0.9	0.92
0.83	0.86	0.89
0.79	0.82	0.84
0.79	0.82	0.84
0.79	0.82	0.84
0.79	0.82	0.84
0.79	0.82	0.84
0.79	0.82	0.84

e. The coordinates of optimal point: $x = 1.114$, $\hat{P}_x = 0.9$, $\hat{r} = 0.0834$.

X=1.214
P_x=0.9
r_x=0.0834

f. The fragment of decision: the possibilities of seeking volumes of investment – the first row and the possible guarantees $P \xi < x$ depending of the growth of risk

Figure 6. The fragments of the complement of adequate investment portfolio

Focusing on the possibilities of the complement of adequate investment portfolio we can formulate the task, which could be the utility object of this method. The perfect object could be the proposed description of the country's universally sustainable development (Rutkauskas *et al.*, 2011) that requires to relate the country's integral sustainability index with the necessary investment volumes, especially focusing on the ensure of reaching objective guarantee with the lowest possible investment costs.

Conclusions

- The terms of universally sustainable development, is the only real possibility for a small country with no abundant natural resources to ensure the independency possibilities of economic and national decisions. On the base of those terms using pragmatic interaction of the objective interests we find the most advantageous use of development resources, considering it with the efficiency of possibilities and reliability such efficiency.
- Functionally properly oriented integral clustering of knowledge, innovation and technologies – is the real way searching for the universally sustainable development resources and proactive implementation strategy.
- The costs structures' optimization of integral knowledge, innovation and technologies cluster is the necessary precondition to achieve the economic efficiency of the cluster.

• Stochastically informative expert systems as the ideology of stochastic optimization has to find its place in both designing the country‘s universally sustainable development strategies and forming the preconditions and resources of its implementation.

• The adequate investment portfolio reveals how constructive instrument created by Markowitz’s random field theoretical background is practically used solving the problems of stochastic optimization.

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