# Optimization of Integral Knowledge, Innovation and Technologies Cluster Structure

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**ABSTRACT—** ***The paper describes the search for an answer to the question – how the structure of knowledge, innovation and technologies' cluster should be formed, when the structure is understood as a set of interacting components of the system and when the object or even functions of the cluster change from being a resource for the object, process or system development, the cluster further becomes the technology of adaptive complex system. The authors synthesize the existing opinions and also reveal their own opinion about the possibility to reveal the interaction among knowledge, innovation and technologies in the context of value creation or resource management, when the object of the cluster becomes the project of country universally sustainable development. In turn, the cluster will be perceived as the sum total of subjects, the main functions of which are intended for the cognition and realization of management possibilities of certain object, process or system. This paper presents the original evaluation performed by the authors in order to optimally allocate the investment resources for knowledge, innovation and technologies among distinctive subsystems of universally sustainable development, as well as to optimally allocate the investment resources inside the cluster among the creation and development of knowledge, innovation and technologies. Using the possibilities of stochastic informative expertise, the experimental distribution of the marginal unit among the components of universally sustainable development has been carried out, which would give the maximum growth of country sustainability index, measuring it by the adequate composition of development components, and experimental distribution of the marginal unit in the cluster among knowledge, innovation and technologies would give the maximum growth of cluster integral functionality.***

**Keywords—** The cluster of knowledge, innovation and technologies, the structure of cluster, technologies of the complex system, universally sustainable development

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## 1. INTRODUCTION

Sustainable development and purposeful integration of science, innovation and technology are the main instruments for the world to overcome the current and potential future challenges. The rapidly evolving globalization and the shaped demand for development sustainability of the country stimulate the continuous integration of knowledge, innovation and technology. However, the contemporary research on sustainable development lacks the quantitative measures and the proportionately unified concept and expression of sustainability, as well as theoretically perfect and pragmatically active perception of knowledge, innovation and technology integration fostering the sustainability of various systems and processes.

If you go deep into The Post–2015 UN Development Agenda, prepared by the United Nations (UN), you can see that for both the ensuring of global economic growth and the increase of growth potential of individual regions or countries, as well as solutions for such global problems as food, health or ecologically unsustainable growth, can be successful only using the purposefully developed clusters of knowledge, innovation and technology (KNIT). We do not have any alternative for the purposeful development of science knowledge and space technology, if we consider the possibilities of global and space disasters. The EU Future Program 2014-2020 treats the future challenges and possible ways to avoid the consequences quite similarly [8]. As well as the Post-2015 UN development agenda, it strongly speaks for the science research shifting from interdisciplinary research towards problematic research.

Both the first and second of the mentioned programs and a number of other UN and EU documents very responsibly describe the development policies and priorities, potential problems and their solutions, discuss the local and global challenges. And almost everywhere the unified approach to the development sustainability as a useful and measurable way to the perspective is seen. Also, the integral KNIT cluster structure appears to be the adequate and most effective tool to achieve the state of sustainable development.

The following relevant problems that received cautious attention should be distinguished among the many projected science research and pragmatic KNIT structure improvement projects.

- what is the compatibility of boundless 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 in order to prevent the boundless sources of development factors from becoming unobtainable;
- 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 problems, and their efficient solution can be the adequate broadening of KNIT cluster. However, the subjective interests and factors probably would dominate here. On the whole, the preparation of the active KNIT cluster allows one to easily understand the main intelligent investment principles seeking for country development sustainability.

## 2. THE FEATURES OF THE FORMATION OF INTEGRAL KNIT CLUSTER STRUCTURE

### *2.1. Cluster as the category integrating the development interests and possibilities*

If you look at the Oxford Modern English Dictionary, the term “cluster” is primarily defined as a “close group or bunch of similar things growing together”. Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the science group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters). Cluster analysis was originated in anthropology by Zubin and Treynor in 1938 and Cattel in 1943. The methodology of cluster analysis is common in many human activities, social organization and the cognition of natural processes and management spheres and its ways and tools of practical use are very varied. According to Vladimir-Estiwil-Castro the notion of cluster cannot be precisely defined, which is one of the reasons why there are so many clustering algorithms.

In this article the authors are focused on the possibility analysis of integral KNIT cluster projecting the strategy of country universally sustainable development and providing the possibilities for implementation of such a strategy. It should be acknowledged that, when transitioning to the category of an integral KNIT cluster, one must slightly extend and change the traditionally established conception of cluster as a group of related objects to a group of subjects whose main functions are related to the understanding and realization of the management possibilities of a certain object, process or system.

In fact, the transition of cluster definition from an expression of certain similarity of its components to a common objective of the functional interaction of its components, poses new, more complicated, demands for the cluster, and also delegates a particularly important mission – to reveal how the functions of elements should interact in the case of a certain goal so that a cluster would become the solution tool of the main economic science problem – how to rationally allocate a non-abundant resource.

Here the integral KNIT cluster has a double advantage in terms of many objects, but it is especially visible when we talk about the projection and implementation of individual country sustainable development. Firstly, the integral KNIT cluster is universally recognized as an inexhaustible source of development factors and, secondly, the integral KNIT cluster can and should serve as a technology of the adaptive complex system implementing the sustainable development strategies of countries with no abundant natural resources.

The supplement of the selected concept of cluster and developing its functional purpose should not cause incompatibility with the content and interaction of development of knowledge, innovation and technologies. The goals and irrational development ways of selected process or system are based on the historically long industrial experience of clusters, based on possibilities of knowledge, innovation and technologies.

The article [29] mentioned the grand roles that have been played and are played by the industrial clusters by increasing the power of national and global economy, focusing on the competence of industrial cluster, here understood as a "set of abilities, commitments, knowledge and skills that enable an organization to act effectively in situations". The article approves an idea that the sources of the competence of industrial cluster depending on the type of cluster, geographical location and other conditions may also become a properly selected structure of cluster factors and the successfully formed horizontal relations and the favorable condition of the economy as well as the period which contained the period of active cluster function, but the exclusive factor of competency is taken to be the successful management of knowledge and innovations, trying to obtain efficient technological solutions. The long-term and universal success of an industrial cluster applied to the KNIT cluster developing the interaction of knowledge, innovation and technologies in production should be the predictor of success for the integral KNIT cluster in much more general situations.

In the scientific literature [3; 5; 13; 25] there is not as much experience in the analysis of KNIT cluster as there is in analysis of the development of industrial clusters, their structure in the context of the possible strategies of the activity evaluating the factors and favorable conditions. However, in principle the KNIT clusters are a natural continuation of the era of industrial clusters, of course, following the powerful changes of globalization which lead to the rate of change of knowledge, innovation and technologies and the interests and forces which decide the content of this change.

It is very important to help to understand the directions of globalization for the sustainable human development using scientific knowledge, and particularly important to note the circumstances that may lead to negative changes and the practically irreparable changes on the Earth and the minds of humanity or individual groups. In practice the problem that becomes most relevant is how to optimally allocate the investment resources for the development of integral KNIT cluster in each of the universal components of universally sustainable development as well as to find an optimal internal structure of KNIT cluster.

## *2.2. Rational riddles of structure of integral knowledge, innovation and technologies cluster*

Although the trio of categories - knowledge, innovation and technologies (KNIT) - are particularly often used together when examining the general characteristics of this cluster or examining the interaction of knowledge, innovation and technologies as subsystems, when the objects of their influence are the same phenomena or systems of reality, but in scientific literature there is insufficient attention to their structural analysis.

Indeed the interaction of KNIT cluster subsystems is particularly difficult, equivalent in complexity to the interaction of biological systems and lacking a sufficiently adequate understanding of adequate cluster structure there remains only a very uncertain possibility of influence when seeking a sustainable development of cluster as well as use of its power. There is no doubt that the structure of a KNIT cluster depends on the object, whose understanding and management requires information generated using KNIT. Such an object will be called a KNIT object.

In any case, the structure of a KNIT cluster can be expressed only with the example of an undetermined set (Fig. 1). It is clear that without the assumption of which object is in the center of focus of the cluster, it is difficult to talk about Figure 1, because it is a collection of unrelated (not linked by the needs of the mentioned object) knowledge, innovation and technology digests.

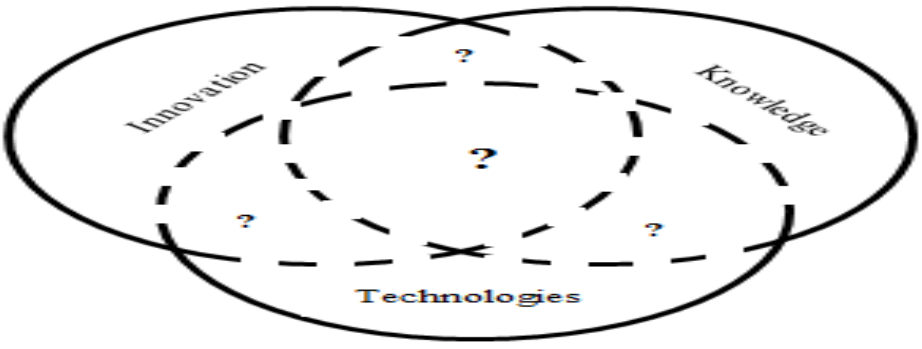


**Figure 1:** Integral KNIT cluster. Source: created by the authors

There is no doubt that with the change of KNIT object, the content of cluster components and the structure of the cluster also changes.

What should a scheme or algorithm be that would standardize both the physical understanding of cluster components and their interaction anatomy, and, most importantly, allow one to understand how to change the cluster structure in order to make a particular change in the condition of cluster object, or what should be the value structure of the cluster that would allow it to optimally (i.e. most efficiently) use the investment resources to carry out its functions. In turn, it is

important to understand, which of the components of the cluster becomes a carrier (potentially the most important to achieve the goals).

Integral hierarchy of KNIT cluster subsystems at this moment can be defined, in a simplified way, as follows:

- In cases where the problem is closely related to topics such as knowledge economy, knowledge society and so on, the leading subsystem is that of knowledge;
- In cases where the problem is linked to the analysis of innovation function system, the leading subsystem is that of innovation;
- In cases where the technological change or technology transmission is at the center, the leading subsystem is that of technology.

Of course, the fact that the cluster of linked knowledge is often already an innovation, the integrated knowledge and innovation cluster are a new technology and the integral KNIT cluster is a technology causes confusion when creating a scheme or algorithm to standardize the understanding of KNIT subsystem interaction.

### *2.3. The pragmatic characterization of the integral KNIT cluster structure*

Often, for the initial understanding of KNIT cluster structure, the model of interaction of simplified military part units is invoked, while the military unit faces a previously unknown enemy. Then the knowledge subsystem is assigned the role of intelligence unit, which using all the possibilities helps to create an adequate image of the enemy, along with that forming a vision of what should be: the operating unit of military actions – the investment subsystem, and the unit of strategic actions – the technology subsystem.

In other words, the knowledge subsystem is the substance which highlights what we know and what we need to know, innovation – the substance ensuring the problem solving in the field of operational development, and technology – the substance mobilizing strategic implementation of objectives through knowledge and innovation. There is no doubt that the process of development transformation is an integral part of the development code, which includes the most important information about what happens if the subsystem is not performing its functions and development process stagnates [6; 7; 16].

In fact, the interaction of scientific knowledge, innovation and technologies even in a simple situation remains complicated and especially important problem of science efficiency management. The main focus of the experiment, which was intended to explain the specific problem by the specific evaluation and the obtained solutions, was intended for the formulation of the principles for cluster structure determination, based on the investment expenses, and for revelation of management possibilities of this structure, seeking to implement the purposes and functions of the cluster.

Since, as stated in the introduction, the main objective is the understanding of integral KNIT functions and the structure, when the cluster object is the projection of universally sustainable development and the cluster is treated not only as a key factor in the development source, but also as a complex adaptive system technology, the primary component is chosen to be technology.

## 3. KNIT CLUSTER AS A SELF-ORGANIZING COMPLEX SYSTEM

In this section an attempt is made to reveal the possibilities of integral KNIT cluster, both after becoming the source of country's universally sustainable development and when choosing this cluster as an adaptive complex system technology.

### *3.1. Integral KNIT cluster as a main source of universally sustainable development factors pertaining to a country*

Considering the development projects of many countries, especially if they do not possess abundant natural resources, the idea is being unambiguously revealed that the main and inexhaustible resource for their development becomes an integral cluster of scientific knowledge, innovation and technologies. The concept "inexhaustible" in the last sentence requires special attention. Since this factor is both naturally evolving and purposefully improved, there is probably no need to talk about its inexhaustibility. However, on the other hand, recognizing that future problems become more sophisticated, and negative processes in many areas of human existence obtain catastrophic speed, we need to understand that even if the resource remains everlasting, for many subjects, including individual countries, it may become unattainable.

There is no doubt that the integral KNIT cluster efficiency evaluation problem should become the object of exclusive attention of national and global science. Unfortunately, little work aims to propose a pragmatic solution for the latter problem. What should be the structure of the integral KNIT cluster, recognizing that the categories of knowledge, innovation and technologies mean the implementation of different functions, and the need for financial resources is also formed in different ways?

In our experiment the object of integral KNIT cluster is the projection of universally sustainable development pertaining to a country (Fig. 2). The concept of universally sustainable development is quite extensively presented for the scientific community [see examples in 17; 18; 19; 20], so there is no need to talk about its content and constructivism.

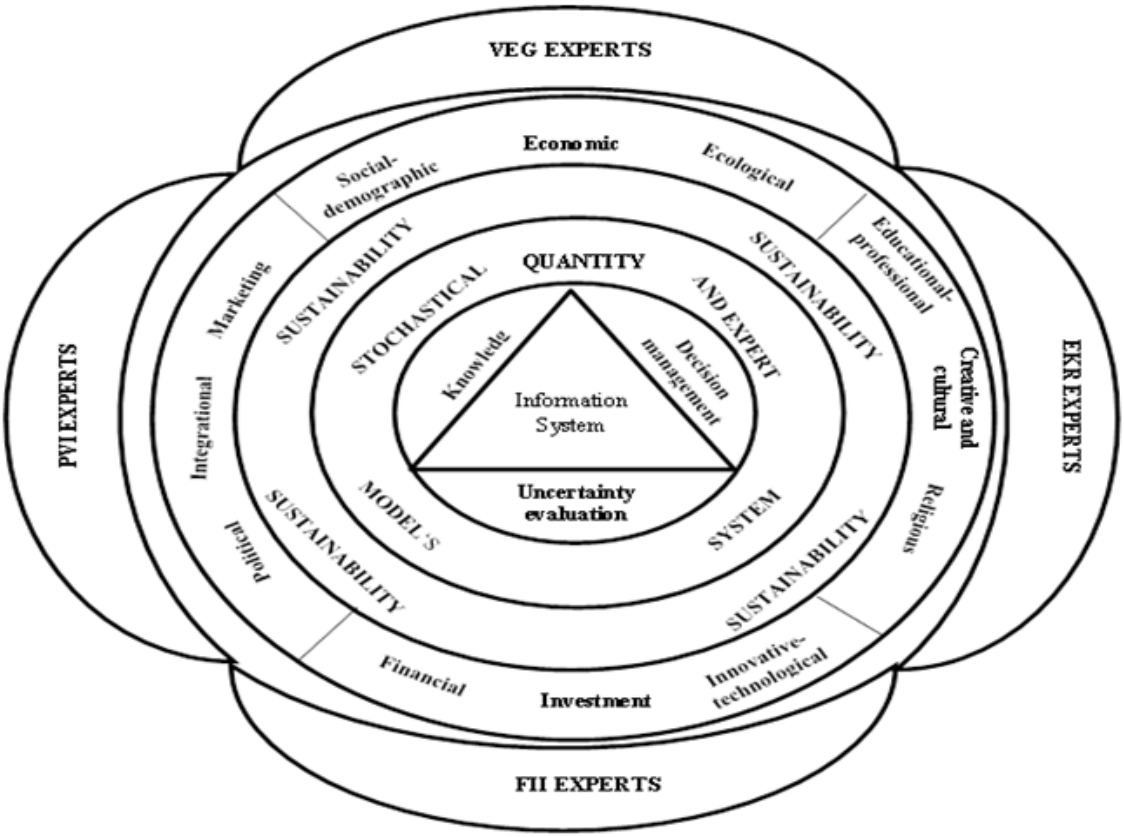


**Figure 2:** The idea of round table: the formation of components for sustainability development and preparation of measures for knowledge and expert evaluation, fostering the development of sustainable management capabilities [18].

The title of this section appeals to the fact that the integral KNIT cluster should be a key source of the universally sustainable development factors. Figure 2 illustrates the fact that all components of universal development sustainability require the help of KNIT for generation of required knowledge, innovation and technologies. It is evident that the cluster has to be adapted to meet the needs of a specific object – the projection of universally sustainable development pertaining to a country.

The title of Figure 2, the idea of a round table, highlights the fact that in the selection of final solution the interests of all development sustainability components or just the experts representing those interests should participate, otherwise there should be adequately formulated criteria. The idea of the round table helps to express a provision that there should be a possibility to quantify and coordinate these interests.

### *3.2. Integral KNIT cluster as the technology of an adaptive complex system*

Understanding of technologies is, on the one hand, increasingly approaching the definition of its unique features: nuclear technologies, nanotechnologies, Internet technologies. On the other hand it reflects more and more the whole of actions and processes, principles, methods and criteria which express the possibility of transforming the original resource, for example knowledge and innovation, into a valuable product such as management system, monitoring and development strategy.

These are apparently the natural changes of thinking logic, because in the case of even a not particularly sophisticated supply of production or service, a network of technologies of the organization and manufacturing of production, supplying, market formation, marketing, finance and so on is formed, the perception of which itself becomes a problem. Therefore it is worth considering whether it is not better to sometimes just choose the ideology of complex network or system organization and management, without doubting that the formally identified object of understanding of the complex system and research instrumentation remained adequate to systems emergent in reality and the interaction of its subsystems and components.

An outlook forms that technologies, innovation or even technological discoveries can come from the side of

managerial effort. It sends a positive signal for multiple service providers because stereotypically they usually stayed beside technologies.

Now among the titles of technologies very often are those which appeal to the business organizational side or the features of possible solutions. So, next to information technologies, the technologies of complex systems, which are oriented to the object, their mutual relations, the processes of changes and the abundance of criteria and especially the complexity, are attempting to win their place in system [24; 26].

Considering the complexity of system management practices an opinion forms that it is apparently useful to choose an already professionally prepared model of the complex systems that has the ability to cover and reveal all the functions typical of a very broad class of complex systems, find the analyzed system among the whole of model's functions and identify it as the particular case. There is no doubt that it will always be the case that the particular system chosen has its peculiar characteristics and that this necessitates the development of the general model. However, it is necessary to always remember that the creation of adequate model for a wide class of complex systems is a long and costly work.

The circumstances presented above apparently form a basis to not overly generalize the understanding of technology as knowledge and skills of using the mechanical tools and applied science results [5; 13; 23] or that the technology is the totality of manufacturing process performance methods and tools [21; 28].

### *3.3. Integral KNIT cluster as a complex system*

Projecting KNIT as a self-organizing system which could be the resource of a country's sustainability development factors and the backing force of sustainability, it is important to adequately perceive the possibilities of knowledge, innovation and technology cluster. Naturally, the formation of the cluster leads to distinction of the mission and core functions of each component, which in turn could be the base for expert evaluation of financial resource requirements. On the other hand, special attention must be given to the understanding of the role of each of the components in order to achieve the strategic objectives of a country's sustainable development [2] and which can be divided into four groups and that are presented in sufficient detail in Figure 2. These are:

1) social, economic and ecological;
2) educational, cultural and religious;
3) political, integration and managerial;
4) energetic, financial and investment.

In turn, here is no doubt that most of the components of the country's universally sustainable development project are potential objects of an adaptively changing integral KNIT cluster, whose objectives can be achieved by means of a complex adaptive system technology or simply by means of technological support of KNIT cluster. But at the same time it must be remembered what growth is expected of the requirements of an integral KNIT cluster so that it can adequately adapt moving from one object to another, or in our experimental case, from one project of universally sustainable development to another. But it is important to know how to choose the typical scheme or algorithm of adaptation to preserve the efficiency of the proposed methodology.

Yet the supreme requirement exists for the KNIT cluster itself, namely that by becoming an agent of social development it should not only not lose status of inexhaustible source of expansion factors, but also remain cost-effective. In the next section, by means of stochastically informative expertise the importance of KNIT contribution at each of the aggregated components of universally sustainable development is evaluated, and the optimal KNIT structure when the object of KNIT remains the same project of universally sustainable development is found.

## 4. THE EXPERIMENT OF INTEGRAL KNIT CLUSTER STRUCTURE OPTIMIZATION

### *4.1. Experimental solutions to optimize the allocation of investment resources among development subsystems of the KNIT cluster and to optimize the structure of integral KNIT cluster*

As it was concluded in the preceding text that the projection of country's sustainable development and the implementation of practical realization means demands the use of the content of adaptive complex system technology and the analytical possibilities. And especially it is important that the preliminary assessments have no objections to the implementation of the above mentioned functions using the integral KNIT cluster. It is therefore necessary to perceive whether the integral KNIT cluster as a model of complex adaptive system and the technology of adequate complex system has a sufficient analytical potency to perform its functions, especially since the integral KNIT cluster should remain the principal source of the universally sustainable development functional factors.

In Figure 2 is presented the componential and sub-systemic structure of sustainable development; in addition, the conception of interaction between subsystem study and the whole of tools for decision formulation and decision making is presented: the systems of information knowledge management solutions, the management of uncertainty and similar,

and the stochastic quantitative solutions and expert evaluation models. An exceptional moment here is the assessment of individual problems, when using collected and generated information, the compatibility between the different aspects of development is found, and the fact that the expert assessment is focused on the methods of stochastic informative expertise. The experts' position says that the system is focused on the formation of quantitative possibilities for interviews, while projecting or analyzing the development system of a country. Practically this means that the information about changes and emerging problems in any subsystem or component is sent to other subsystems, which, in turn, give their own response.

However, we find that the named problems of country's sustainable development projection and strategic implementation should naturally be solved in the context of management of science, knowledge, innovation and technologies. Yet naming the main source of development factors for the country's universally sustainable development and the adaptive technology of complex systems should be the integral KNIT cluster, we have to admit that it is necessary to have a pragmatic outlook on the cluster possibilities and results in the specific situations.

In both scientific and pragmatic literature, with an optimistic outlook of the possibilities of KNIT cluster, doubts are voiced ever more often regarding whether there are sufficient human efforts for the fully-fledged performance of KNIT cluster functions. Doubts form encouraged by different motives and reasons, but among them there apparently are these particular aspects:

- Globalization, which opened up new possibilities for human progress, also brought a wealth of problems, which, if left unsolved or even unexplained, can create one or even several new Towers of Babel on Earth. The same can be said about the primitive understanding of competitiveness especially when not taking into account the short-sightedness of competitive principles;

- The KNIT cluster efficiency also demands its universality. The level of KNIT cluster should be fairly balanced in all areas of development. At the same time, special attention should be given to the fostering of the optimal KNIT cluster structure;

- Apparently, there is no way to miss a global principle of decline of the marginal operating cost. Therefore, an intelligent investment strategy, both in specific countries and activities and on global scales will eventually become the most important problem of KNIT cluster sustainable development.

In a quite representative article, based on the schemes presented above [12], the authors name a multitude of positive possibilities of a KNIT cluster, but the final section provides a fairly informative summary where and why the EU did not reach the results that have been declared as guaranteed to be reached by the turn of the millennium.

Unfortunately, the authors, based on their own and other authors' [1; 4; 9; 11; 12; 15; 22; 27] works, identify that the EU did not reach the necessary balance between the created scientific knowledge and the desired level of innovation and technologies in EU countries. Also the authors present the principal reasons – too small a fraction of scientific research is financed by businesses, too much reglamentation of scientific research in business, unbalanced scientific research and innovation policy in business. Clearly, there is a lot of truth in these comments, but a deeper development analysis of the KNIT cluster should pay attention to the three groups of factors named above, that prevented the EU from becoming an equal user of KNIT cluster possibilities, compared to the USA and Japan.

Apparently, the EU has not become the object of integral KNIT cluster or it is not yet possible to prepare such a KNIT cluster model that would have analytical capabilities suitable for analysis of EU condition and expansion opportunities and serve as a technology of adaptive complex system when preparing and implementing the strategy of sustainable development of the EU.

The countries or regions, for which there is no alternative besides the integral KNIT cluster as a source of development factors, should be interested in efficiency of economic KNIT cluster and especially the problems of rational use of investment resources. These problems could be solved by optimizing the investment resources among the possibilities of KNIT in separate development subsystems and by optimizing the structure of KNIT cluster itself. Further the experimental version to solve these problems is presented.

The universal sustainability of a country is measured by an exponential growth function:

$$y = e^{f(x_1)+f(x_2)+f(x_3)+f(x_4)} \tag{1}$$

where: y – projected integral (gross) index of development sustainability;

$x_i$ - the law defining how the marginal investment unit in the $i^{th}$ component of development converts into potential component of integral sustainability index (i=1, 2, 3, 4). (see Figure 2);

$f(x_i)$ - the function describing how a mentioned potential possibility is transformed into a real integral component

of sustainability index in the context of 1st equation.

In this way we associate the possibilities of investment with the volume of development components sustainability growth and, in turn, with the subsystem of integral sustainability.

The 1st dependence indicates that in the absence of investment in a point in time, the growth possibilities of the index of the integral content also disappear. So, intelligent distribution of investment unit may be quite informative also about dynamics of sustainability.

Thus, the distribution of marginal unit between the development components of KNIT clusters, in order to obtain the maximum growth of integral sustainability index, will be perceived as the above mentioned criteria of problem – how to distribute the marginal investment unit among all the development subsystems of KNIT cluster to achieve the best growth of integral sustainability.

Similarly, we also have to formulate the problem of integral KNIT cluster structure optimization. Here the functional dependence is used:

$$y = e^{f(\bar{x}_1)+f(\bar{x}_2)+f(\bar{x}_3)} \tag{2}$$

where y – the effect which is given by the marginal investment unit among distributed components of KNIT cluster;

$\overline{x_i}$ - the law describing the $i^{th}$ component of contribution of marginal investment unit, forming the potential effect of $i^{th}$ component;

$f(\overline{x_i})$ - the function describing how the potential possibility is transformed into the real $i^{th}$ component and its impact on general KNIT cluster.

$\overline{x_1}$ - knowledge, $\overline{x_2}$ - innovation, $\overline{x_3}$ - technologies.

Thus, as in case of the above mentioned problem, we obtain that the $x_i$ are the laws describing how the marginal $i^{th}$ component of the cluster generates the potential benefit and $f(x_i)$ describes an algorithm how to evaluate the contribution for the real benefit of investment unit in the context of 2nd function. Here the criteria of optimization can be identified – it is the distribution of marginal investment unit among the knowledge, innovation and technologies.

Since the investment unit becomes the indicator of the potential sustainability in a particular subsystem of development, and measuring the integral development sustainability by the real sustainability indicator they are the stochastic processes, thus solving the problems of derived rational distribution of resources among the various development components of KNIT cluster and its the optimal structure of development, the integral KNIT cluster structure establishment, we will use the technique of adequate investment portfolio stochastic optimization (Figure 3).

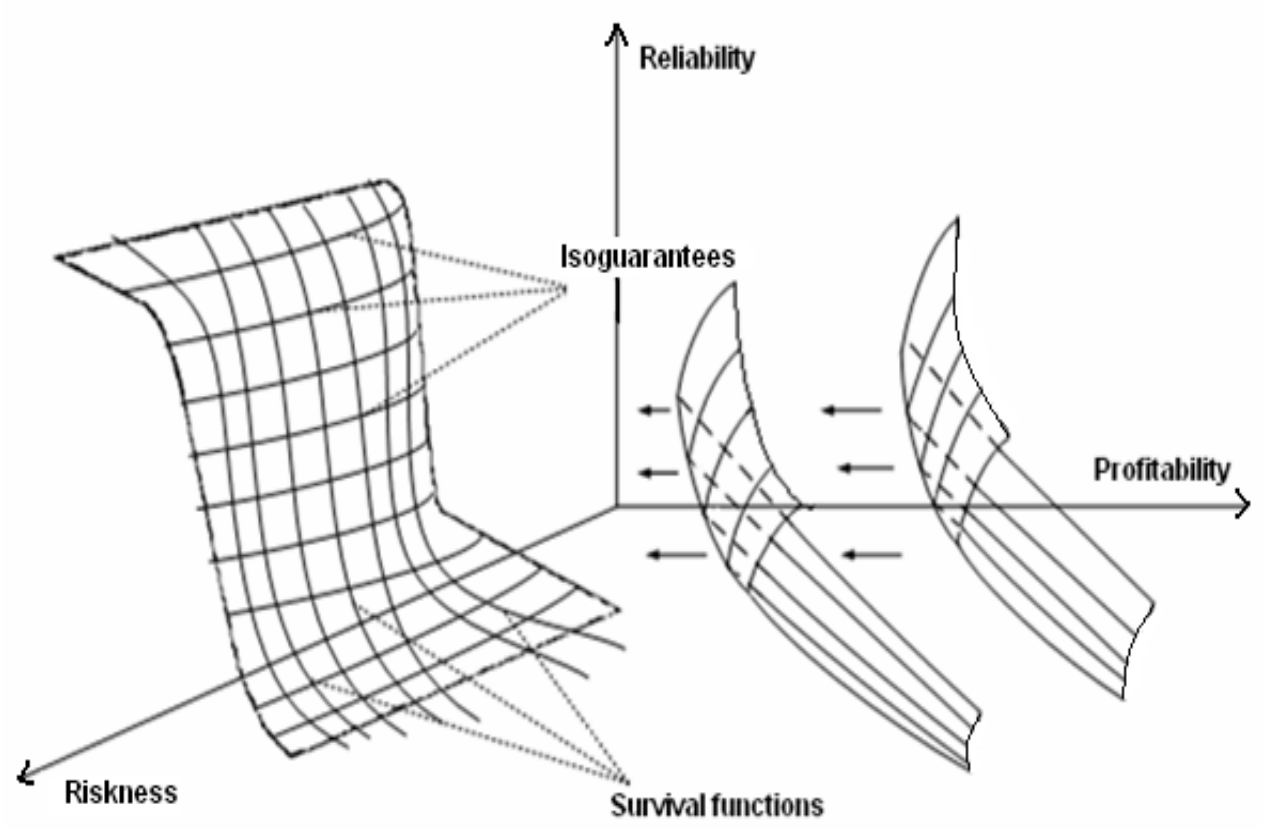


**Figure 3:** The scheme of stochastic optimiztion problem solution, where a set of the potential solutions is the network of isoguarantees and survival functions, and the utility function is composeed of the set of functions depending on the efficiency, reliability and riskness of possibilities

### *4.2. General results of the evaluation*

Practically, now it is impossible to gather the statistical data or the analytical estimates which lets to evaluate the (1) and (2) parameters. Therefore for the describing of the parameters necessary for the solutions of first and second task were selected the groups of experts who very actively used the principles of the stochastic informative expertize.

The experts suggest that rates of the laws or indicators $x_1, x_2, x_3, x_4, \overline{x_1}, \overline{x_2}, \overline{x_3}$ should be the probability distributions with the appropriate forms, probable averages and standard deviations.

$x_1$ - is the normal distribution with the average $\alpha$=0.03 and standard deviation $\sigma$=0.01 or simply $N(\alpha_1 = 0.05, \sigma_1 = 0.02)$;

$x_2$ - is the lognormal distribution: $LN(\alpha_2 = 0.065, \sigma_2 = 0.02)$;

$x_3$ - is the Gumbell distribution: $GB(\alpha_3 = 0.02, \sigma_3 = 0.009)$;

$x_4$ - is the Triangle distribution: $TR(\alpha_4 = 0.44, \sigma_4 = 0.015)$.

Note. For the control of the expert evaluation and justify of decisions parallel were done the evaluations, when all $x_1, x_2, x_3, x_4$ are the normal distributions with the above mentioned parameters. The results of calculations are shown in Table 1 (and in Rutkauskas *et al.* 2013), where are the main and control variants which are listed next to each other.

The Table 2 shows the optimal structure solution of KNIT cluster, when the experts have found that:

$\overline{x_1}$ - $N(\alpha_1 = 0.04, \sigma_1 = 0.02)$

$\overline{x_2}$ - $N(\alpha_2 = 0.04, \sigma_2 = 0.03)$

$\overline{x_3}$ - $N(\alpha_3 = 0.07, \sigma_3 = 0.04)$

**Table 1:** Project selection matrix rules

| **Control case** | | | | **Expert case** | | | |
|---|---|---|---|---|---|---|---|
| $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_1$ | $x_2$ | $x_3$ | $x_4$ |
| Normal distribution for all | | | | Gumbell distribution | Laplace distribution | Normal distribution | Lognormal distribution |
| Distribution resource between subsystems | | | | | | | |
| 0.38 | 0.08 | 0.28 | 0.26 | 0.26 | 0.32 | 0.2 | 0.22 |
| Efficiency parameters: e – 1,023116; p – 0,57; r – 0,013701 | | | | Efficiency parameters: e – 1,151202; p – 0,57; r – 0,029649 | | | |

As mentioned in the introduction to the article, here we describe experiments in finding the optimal allocation of resources, forming an integrated knowledge, innovation and technology cluster in order to universally sustainable development in Lithuania. Trying to directly identify and generate the knowledge, implemented technologies and cherished innovations for longer perspective would require the analysis of quite debatable problems since most already set universal component of sustainable development is social – economic. Here, the identification of technologies and innovations and assessment of their need of cost implementation provoked a lot of discussion 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 [10; 19] and here reformatted for opportunities analysis of universally sustainable development through in the previous paragraph used stochastically informative expertise principles for the optimal allocation of financial resources among four integrated components of universal sustainable development. Results of the assessment are provided in the Table 2.

**Table 2:** The optimal allocation of financial resources between KNIT cluster components

| KNIT components | | |
|---|---|---|
| Knowledge | Innovation | Technology |
| The marginal cost per unit of component | | |
| 0,19 | 0,30 | 0,51 |
| e=1,1007 p=0,56 r= 0,331 | | |

## 6. CONCLUSIONS AND SUGGESTIONS

Many specialists and politicians ensures that integral KNIT cluster becomes not only the everlasting sources of the possibilities option development for the necessary survival of humanity on the planet Earth but also the adaptive complex system technology while projecting and implementing the work on Earth.

In turn, the integral KNIT cluster requires a much greater attention of specialists on educating the universality and adaptability of cluster as well as formation of rational costs structure for cluster to secure the status of economically efficient complex system.

Particularly important optimization problems are universality, functional flexibility and cost structure of KNIT cluster. Inevitably arise the question or KNIT cluster as an inexhaustible source of funds to be financially inaccessible to many subjects including individual countries and regions.

Experimental testing how to allocate the integral KNIT cluster as an adaptive complex system model for universal sustainable development becoming universal cognition and projection and as an adaptive complex system technology for implementation of country's universally sustainable development revealed and dictated the real cluster cognition and problems of development.

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