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# Threats Management Principles for Development Programs of High Technology Industries in Turbulent Environment

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## Abstract

A system of threats in the development of knowledge-intensive industries based on the images in the format of "bubbles" was considered in this article. Analysis of existing models and methods of threat management development programs within such industry was performed. A three-level model of the high technology production within institutional, managerial and technical levels was also considered. Classification of threats in high-tech industries development programs was determined, based on their reaction - deviations (reactive) and resentment (proactive). An immune mechanism as a response to threats and challenges in the development programs was also considered. Key unit diagnostic mechanisms and critical threats, which belong to the field of Pareto, working out alternative scenarios for threat management, the formation of a full immune response to a threat to the region Pareto taking into account their mutual influence and realization of immune response in the form of high-tech industry development project were all considered in the article.

**Keywords:** management mechanism; development programs; turbulent environment; immune reaction

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## 1. Introduction

The rapid development of project and program management methodologies requires the creation of innovative models, methods and mechanisms based on the convergence of different subject field knowledge. Over billions of years nature has created a variety of living organisms with unique survival mechanisms in dynamic and sometimes aggressive environment. Some of such mechanisms are protective (immune) mechanisms, which develop special reaction to the threats. The process of knowledge transfer from one domain to another was formed in the 1950s, within the similarity theory of mechanical, electrical and biological systems.

## 2. Analysis of recent achievements and publications

Let's consider the use of different methods of analysis of threats, including self-test, in the development of project-oriented systems.

Diagnostics in the context of life cycles analyses of products, technologies of production, management processes of operations, business development and implementation, is usually carried out in the framework of management system using the model of the project-oriented organization life cycle (Prigogine, 2009). When threats of an organisation are analysed, whether this is done by personnel themselves, or using the help of specialised consultants, it determines the position of the organisation in its development, its passed crisis points and its expected further

development (Azarov, 2012). In the process of forming a development programme for high-tech production, complementary chains of projects are formed based on certain horizons of vision. At each step of the process there is a clarification of project's vision and corresponding synchronization.

The use of diagnostic tools depends on the development strategies for the project-oriented organization and the state of the context. Thus, the strategy of a breakout in the development of new markets and the competitive edge is stipulated with the high level of innovation of influential competitor in the market segment of knowledge-intensive industries. Identification of positive reaction in management processes is one of the elements of the concept of growth cycle and allows to look at the balance of efforts and dynamics of competition in current market conditions, to identify and classify growth accelerators - factors that ensure sustainable development of high-tech industry, and to provide managers with a new tool for modelling corporate strategy (Kerzner, 1998).

When Analysing threats, an organization is considered at the following levels:

**Institutional level**, which is the top management, which forms the purpose of high-tech enterprise, planning strategy, business implementation and development of organisation. This level of management is carried out by the top managers or top executives. The competence level of these managers is important decision making for the company as a whole. Top managers are mainly involved in the development of perspective plans and long-term programs focused on company adaptation to changes in external environment as well as definition of applied methods, tools, technologies and systems to improve performance of organisation's business and productivity of the enterprise' employees as a whole.

**Managerial level**, which is the middle management, intermediate between strategic management and routine for implementation of the current tasks of the enterprise. The competence level of this management is determined by decision-making within the subdivisions of the enterprise and the realisation of its tactical objectives. Middle managers are typically in charge of subdivisions and/or departments within organizations. These managers are mainly engaged in management and coordination of high-tech enterprises. They make decisions on various forms of activities and efforts of various departments.

**Technical level** is the lower management, which is directly involved in supervising production staff. Managers at his level generally supervise the implementation of production objectives, deal with daily operations and the actions needed to ensure efficient work without disruption in business processes.

One the key tools for threat analysis in the development is *structuring*.

The following examples of project structures may be considered:

- tree of objectives;
- tree of tasks (work);
- tree of products (results);
- problem tree;

- decision tree;
- work breakdown structure;
- organizational structure of the project;
- and so on.

The structures are developed on basis of analyses of systems and models. One of the main methods of structural analysis is decomposition. Decomposition is a conditional technique that allows to introduce a system in a useful form and assess its complexity. As a result of decomposition individual structural elements of a system and the relations between them are categorised based on their characteristics. Decomposition is a way of avoiding threats in high-tech industry through development of understanding of a system. The depth of decomposition is determined by the order and complexity of a system, as well as the objectives of the task in hand.

The use of structural models leads to requirement for their classification. Classification of objects represents their conditional grouping by given characteristics in accordance with a certain purpose. For various purposes same organizational threats may be classified differently. The classification is not an end in itself, it is imposed by the theory and practice needs. Effective classification of models provides convenience when choosing methods of modelling threats and achieving desired results.

Initialization conditions of high-tech industries development projects depend on the sources of its creation. As any living organisms, projects are born, realized ("live") and completed ("die") according to certain laws. It should be noted that the projects are not "born" accidentally. Every "new-born" project has its own story, "background" and "genetics".

The use of biological analogies, as suggested above, in project management mechanisms allows to use and transfer knowledge and experience from biological science. Development of biological science, although it is a descriptive science, offers an excellent opportunity to detail the fields of project management methodologies that are not yet considered.

The analogy allows the use of relative structure and configuration of objects in one subject field to create "skeletons" for detailed elaboration of structural features of objects in the field being studied. As an example of this biological concepts of "genetics" and "immune mechanism" are being used in the field of project management.

The purpose of "genetics" project as a science was to identify the general laws of the transfer of knowledge from one project to another. For this, specialists had a task of identifying the mechanisms underlying the laws of genetics and associating them with project structure elements. In the process the question came up of how and in which manner the project and its "genetic information" may turn into characteristics of the developing project. "Genetic information" of a project covers the whole range of features and characteristics that the project has during its lifecycle, from the moment of its "birth" until completion. Each project exists in its own environment and the formation of its structural features occurs in well-defined conditions, with each structure dependant not only on "hereditary background", but also on the conditions in which the structure is implemented and developed on the basis of the "model of the environment."

The process of creating a genetic model can be considered.

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During its growth, each organisation is faced with certain difficulties, challenges and threats. At each stage of organizational development these can be divided into two categories (Adezis, 2009):

- growth threats, i.e. problems caused by the immaturity of an organization, which are difficult to avoid (like children's infectious diseases);
- organizational threats (internal and external), or difficulties which may relate to certain phases of organization's development.

If correct strategy and tactics of development are used, the high-tech production can achieve prosperity and, in principle, remain in this state for a long time, contrary to the analogy between the development of a business organization and a living organism.

The modern practice of system creation and development in project management shows that each methodology is formed from scratch. As such the same mistakes can be repeated many times. Project management methodology is regarded as a basic tool for development, control of organizational "disease" and formation of its competitive advantage (Bushuyev, 2012). It is argued that creation of a knowledge management system of project portfolios and program management methodologies are a promising research trend. The use of knowledge of protective (immune) mechanisms in the living world in the construction of methodologies, allows the use of the immune system structure, as a knowledge-carrier of project management methodologies of the high-tech industry. This structure allows to divide the knowledge of methodologies into classes and to use that knowledge in creating effective project management methodologies that are adapted to the specifics of the enterprise and classes of projects and programs (Azarov, 2012).

### **3. The purpose of the study and problem formulation.**

The aim of the article is to build a mechanism for development of programs for threat management in turbulent environment.

1. To analyse existing mechanisms of threat diagnostics in programs of development
2. To classify threats (external - internal; by zones of turbulence with reference to the book, by expected losses in the system during program implementation.)
3. To build a conceptual model that will include mechanisms for diagnosis of threat-response mechanisms in the development programs of high technology industries.
4. To create a case study through development programs of high-technology industry in turbulent environment.

The main hypothesis of the study is that the key factor of success of high technology industry development programs is development and use of diagnostic and threats management mechanisms.

### **4. Conceptual model of analyses programs threats**

The following structure of the threat classification is used, by classification features (Yaroshenko, 2012):

- those concerning the organization - external, internal threats.
- those concerning the environment - by turbulence zones: green, yellow, red, brown and black.

- those concerning expected losses in the system during program implementation: insignificant, essential, destructive for the organization.

Conceptual model for analyses of program threats defined during project life cycle. Basic principles of conceptual model are:

- model must take in account uncertainty, risks and threats;
- model must take into account interactions between uncertainty, risks and threats (fig. 1).

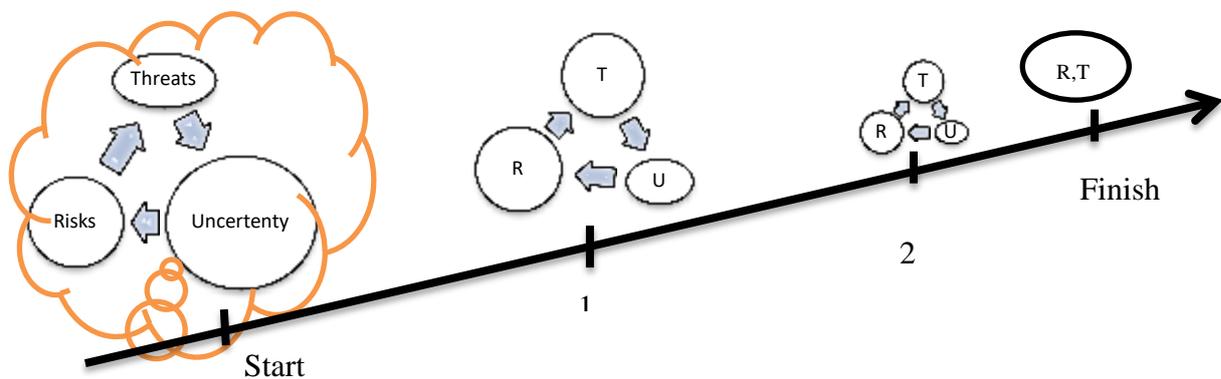


Fig. 1. Conceptual model for analyses of program threats

According to the proposed concept at the start of the process there is big uncertainty, small risks and threats with vision 'in cloud'. In the next phase uncertainty becomes smaller while risks and threats become realistic. At the end of the program there is transformation from risks and threats of program to products while uncertainty becomes zero.

## 5. Management of threats in developed programs

### 5.1. Case study 1. THREATS TO INDUSTRIAL HIGH TECHNOLOGY ENTERPRISES

Currently, there is not much literature dedicated to the problems of threats to industrial high technology companies, in spite of the fact that they are the most risky businesses. For efficient organization of risk management at industrial enterprises it is necessary to develop classification of threats.

Analyses of literature showed a lack of clear and structured integrated classification of threats in an Industrial High Technology Enterprise (IHTE). Therefore, classification of threats in accordance with the functional components of IHTE was proposed. With this in mind, an enquiry form, which included the main threats of IHTE was drawn up and an expert survey was performed.

The views of experts in the field from the leading industrial enterprises were gathered.

Analysis of the proposed threats classification of IHTE was carried out using the weighting coefficients obtained by the expert methods of estimation. The experts were asked to rank the threats to IHTE in order of importance. In this case 10 experts were interviewed according to each threat to each of the IHTE functional components.

A criterion of estimation was the significance (weighting) of risk, i.e. which of the listed threats to IHTE were considered by the experts to be the most and least important for the stable operation of the company

The first rank was assigned to the most significant threats to the IHTE.

As rank increased the significance of threat decreased. The last rank (depending on the number of threats in the functional component of IHTE) was assigned to threats which were considered to be of least importance for an enterprise.

After processing the inquiry form for each indicator, the rank total ( $R_i$ ) was calculated taking into account the opinions of all the experts:

$$R_i = \sum_{j=1}^N r_{ij}, \quad (1)$$

where  $r_{ij}$  is the  $i$ -th threat rank assigned by the  $j$ -th expert.

To move from the rank estimates  $r_1, r_2 \dots r_n$  to the weight coefficients ( $a_i$ ) Fishburn's formula was used, as follows:

$$a_i = \frac{2(n-r_i+1)}{n(n+1)}, \quad (2)$$

where  $n$  is the number of estimated objects (?).

This formula was used because it assumes linear weight decrease from rank to rank.

Table 1 shows the classification of IHTE threats obtained as a result of the expert survey and calculated weighting coefficients.

An important point of the expert procedures is evaluation of experts' action concordance and reliability of expert scores.

To determine this, coefficient of concordance was used. The value of this coefficient gave an indication of the degree of concordance of expert opinion and, consequently, of the reliability of their scores.

**Table 1.** Results of the expert survey

Functional component of IHTE	Classification of threats to IHTE	$R_i$	rank	$a_i$
1. Finance	Objective:			
	1. Circumstances outside one's control or similar to them in themselves or in sources of appearance. (political, of macroeconomic nature, economic, national, religious issues)	34	3	0,2
	Subjective:			
	2. Inefficient budgeting of all aspects of activity	20	2	0,3
	3. Unqualified enterprise asset management	10	1	0,4
2. Production	1. Non-conforming production (non-compliance with requirement of time, unable to manufacture competitive products)	14	1	0,4
	2. Non-conforming supplier of components, raw materials, expendable materials etc.	16	2	0,3
	3. Insufficient awareness about innovative technologies	36	4	0,1
	4. Inappropriate infrastructure	34	3	0,2
3. Marketing	1. Limited market for final product	25	2	0,24
	2. Non-compliance of the products with market requirements	13	1	0,29
	3. Risks related to market development	39	4	0,14
	4. Insufficient awareness about changes in the market	53	6	0,05
	5. Non-professional advertising	45	5	0,1
	6. Risks related to market conditions (exchange rate risks, price variance risks, competitive expansion risks)	35	3	0,19

From the above, the coefficient of concordance ( $W$ ) is determined using the following formula (3):

$$W = \frac{12 \sum_{i=1}^n (\sum_{j=1}^N r_{ij} - \frac{N(n+1)^2}{2})}{N^2(n^3 - n) - N \sum_{j=1}^N L_j}, \quad (3)$$

where  $N$  is the number of experts;

$r_{ij}$  is the rank of the  $i$ -th threat assigned by the  $j$ -th expert;

$L_j$  is an indicator of related ranks of the  $j$ -th expert.

$L_j$  value is determined by the following formula:

$$L_j = \sum_{v=1}^{k_j} (k_{jv}^3 - k_{jv}), \quad (4)$$

where  $k_{jv}$  is the number of the same ranks in  $v$  group of the  $j$ -th expert;

$k_j$  is the number of groups of indicators with the same ranks of the  $j$ -th expert.

The coefficient of concordance  $W$  can vary between 0 (where there is complete lack of concordance) and 1 (in the case of agreement of the ranking results of all experts). The degree of concordance of expert evidence is considered acceptable if  $W \geq 0,7$ .

**Table 2.** The results of experts' opinions concordance

Functional components of IHTE	Coefficient of concordance
1. Finance	0,9
2. Production	0,81
3. Marketing	0,59

Table 3 below shows the most significant threats to IHTE, which were found according to the experts as a result of the calculations

**Table 3.** Most significant threats to IHTE

Functional component of IHTE	Threats names of IHTE
1. Finance	Inefficient enterprise asset management
2. Production	Imperfect production (noncompliance with requirement of time, unable to produce competitive products)
3. Marketing	Noncompliance of the products with market requirements

Ensuring compliance of each functional component of IHTE with requirements may be achieved by carrying out an individual set of measures for each component.

It was noted that all of the functional components of IHTE were closely interrelated and hence it would not be possible to achieve stability of an enterprise through adjusting just one of these components, without bringing the others to the required level

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On the basis of expert survey mentioned above, classification of industrial enterprise threats was proposed for practical use, allowing develop directions for the preventive measures to ensure the stability of the industrial enterprise.

### ***5.2. Case Study 2. Assessing and developing organisational competence in PROJECTS with High risks and threatS as seen at Chernobyl Nuclear Power Plant (ChNPP)***

In the 1980s, ChNPP was one of the most powerful nuclear power plants in the USSR. According to the strategic development plans of power industry of the Soviet Union, the ChNPP had to become the largest nuclear power plant in the world, consisting of six power units with an electric power of 1000 MWt each (corresponding to 3200 MWt of thermal power each respectively).

However, the devastating explosion of the fourth power unit of ChNPP on 26 April 1986 changed everything. The accident caused an emission of a huge amount of radioactive materials into the environment. About 600.000 people participated in elimination of consequences of the largest accident in the history of nuclear power, 200.000 people were evacuated and moved out of the area, and the health of 1.7 million people was undermined. The death-toll related to the Chernobyl accident, including those died from cancer years later, according to official data sources was estimated at 125.000 people.

In 1986 in just six months, in difficult radio-active conditions, scientists and experts of the former Soviet Union designed and constructed a protective cover for the damaged reactor, which was named the "Shelter", and was later renamed to "Sarcophagus". Implementation of design decisions during construction of "Shelter" object in a difficult radiation situation demanded implementation of a range of organizational and technical actions to ensure radiation protection of the personnel. Practical implementation of the fundamental principles of radiation safety while carrying out dangerous works was reliably supported by the strictest discipline and quickly developed and put into practice instructions and regulations of performance of all radiation-hazardous works.

In 1994 political leaders of the world, represented by the G7 and the European Union requested that the Ukraine stops operations of the remaining nuclear power stations of ChNPP. In 1995, the Ukraine signed a Memorandum of Understanding to stop power units of the ChNPP which eventually happened in 2000. A year later, the State Specialized Enterprise Chernobyl NPP (SSE ChNPP) was formed by the Ukrainian Government to decommission the existing power units and to transform the "Sarcophagus" into an ecologically safe system.

A complex three-stage program was started. In Stage 1 the objective was to stabilize the existing "Shelter" by increasing reliability and durability of the old structures and systems. Stage 2 was aimed at creating additional protective barriers, firstly through creating a new safe confinement providing necessary conditions (e.g. to ensure safety of the personnel, the local population and environment), preparatory technical work and the infrastructure for stage 3. This included erection of the "New Safety Confinement (NSC)", which was an arched construction with a width of 257.4 metres, a height of 108.4 metres and the length of 150 metres. The NSC was designed for 100 years of operation to give the chance to carry out extraction of fuel-bearing materials and their conditioning for the subsequent safe storage (Fig. 2).



**Fig. 2.** NSC after second lift of eastern section in 2013

After the erection of the NSC in 2015, stage 3 would start and is planned to be carried out by 2023. It is aimed at the extraction of fuel-bearing materials and long existing radioactive waste, their conditioning and burial in radioactive waste storages in accordance with existing standards, removal from operation of the "Shelter" and dismantling of unstable structures of the "Sarcophagus"

Financing of works on the international project (the plan of implementation of measures on "Shelter" object) is carried out at the expense of the donor countries of the international Chernobyl Fund "Shelter" (ChFS). The European Bank of Reconstruction and Development (ERDB) provided the help to the government of Ukraine in organising of the international conference on fund-raising to cover the missing financing of the program. As a whole, the construction of the NSC arch is expected to cost in excess of 1 billion Euros.

One of the challenges for the ChNPP was the lack of personnel with sufficient experience in implementing such a complex program and with coordination of all related projects. A Project Management Unit (PMU) was formed to establish standards for project and program management in accordance with the internationally acknowledged standards (Bushuyev, 2014). The PMU of ChNPP worked closely together with Ukrainian Project Management Association (UPMA) and Kiev National University of Construction and Architecture to develop the standards and the competence of personnel involved in the program and projects with application of IPMA OCB model (IPMA OCB, 2013).

### **5.3. Case Study 3. KEY THREATS WITHIN THE INNOVATION PROGRAM OF UKRAINIAN PUBLIC FINANCE SYSTEM**

What does it mean to be successful in this dynamic and often turbulent world? The answer to this question both simple and complex at the same time. To be dynamic? Not only that... There is a need to be proactive and focused on value creation, by using the trend of passing to the economy of knowledge, making timely changes in management pattern and understanding the philosophy of life cycles. It is important to reload the system in time, to be creative, to develop knowledge and perfection centres. Each of these elements is a key to success, and the formula for success is determined by their interaction. The keys to success of projects and programs of complicated systems` reformation form the development programs` management methodology, defined in the following sections.

The Keys to successful reformation of complicated systems, using public finance system of Ukraine (Yaroshenko, 2012) as an example, are considered below, with the focus on their mechanisms and methodology.

## **6. Keys to successful program management**

### **6.1. Key 1. Be proactive**

#### **6.1.1. Have a formalized model of the future**

Ministry of Finance of Ukraine devised and applied a model of proactive management of public finance development shown on Fig. 3. (Azarov, 2012).

This model was constructed by taking into account potential falls in the critical points (points of bifurcation) in public finance development and allowed creation of a program that took into account critical events and focused on success (Adizes, 2009). Analysis of the model shows that, within the first 2 years of the start of implementation of the program, there were potential crises in the following segments: transition to professional management in the course of administrative reforms, autonomy at the local budgets, relations of "centre - regions" and manageability. All of this resulted in the loss of trust (critical point 6).

Figure 3 focused on the segment of 2010-2011, where actions had been relating to the critical points of the model given below.

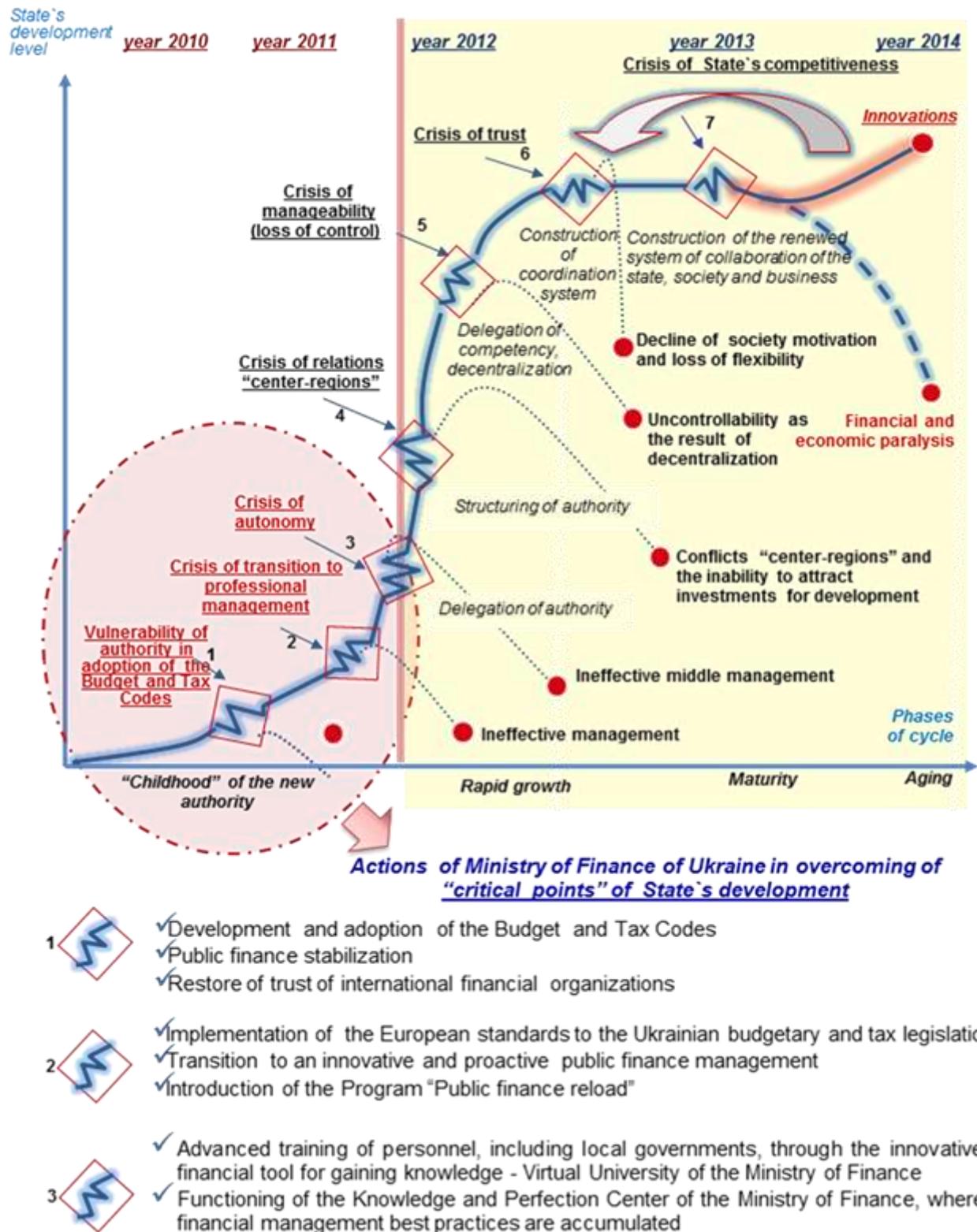
The Government plans were to apply three models of fiscal policy: 2010 - economy of patience; 2011 – transition from economy of patience to stabilization and development; 2012-2014 – driving force of building a competitive economy, based on social orientation through stimulation of production and consumption chains by focussing on proactive nature of the development of medium-term planning model, decentralisation of revenues and expenses and the support of investment and innovative model of development of Ukraine.

#### **6.1.2. Look into the future**

Whenever a new project or program starts, we are typically faced with the following questions:

What is the future? What should be expected? How to assess the vision of the future within reach, uncertainty, threats and risks on the way and results?

An effective manager must be a "visionary" because only a vision of the future product and its implementation can ensure success of the project (Azarov, 2012).



**Fig. 3. Model of proactive program management of public finance development**

### **6.1.3. Understand and use the trends**

Management based on trends makes the process proactive. The art and science of analysing trends is a method that a team uses in the process of management development, by generating and analysing of the new ideas or development strategy.

Trends never arise out of nothing and never stop without reason. One of the trends that accompanied the development of Ukraine for example, was a "demographic hole" created by the decline in fertility during the restructuring and formation of independent Ukraine. The strategies for responding to this trend included opening of borders for labour migration, trend-oriented economic conversion, promoting fertility etc.

The integrated influence coefficient is based on hypotheses about the conditional independence of the influence of trends or its groups on the budget of Ukraine and the consequences of the lack of time.

### **6.2. Key 2. Focus on value creation**

As an example of this, a new model of fiscal and target programs management is considered. Instead of budget allocation it focuses on value creation for the parties concerned. In this regard, it becomes necessary to determine the structure and components of what constitutes value for key stakeholders, develop estimation methods for models and values (assets, skills, knowledge and innovation) and implement models and methods using methodology of management of innovation development.

In addition, the goals set out have to be coordinated with the mission of public finance system. They have to become the driving force of reforms and economic development of Ukraine on the basis of innovative management techniques (Bushuyev, 2010).

The steps to achieving success of the management model are as follows:

- changing the way of thinking and behaviour of the parties involved;
- optimization of business processes;
- increasing system flexibility (i.e. its capacity and capabilities to adjust to the requirements and vision of the stakeholders in resource and product management);
- elimination of variability and immaturity;
- reducing process duration;
- applying tools aimed at prevention of different kinds of over expenditures.

### **6.3. Key 3. Move towards a knowledgeable economy**

As an example of this, a model of knowledge and excellence is considered. It is based on project approach, cognitive models of accumulated knowledge and technological maturation. These elements constitute the basis of the conceptual model of innovative development (Neisvestny, 2013).

System transition to a new management concept requires the following:

- to build a structural model of accumulated knowledge;
- to identify the source and knowledge content to be placed in databases;
- to prepare staff for the transition to formal knowledge display;
- to encourage staff to accumulate and use knowledge.

#### **6.4. Key 4. Change the management model by creating and implementing formula for success**

Making this key successful was achieved through:

- formation of the vision of life cycles of products, processes and systems;
- development of a formula for success based on trends and new philosophy management;
- implementation of a new management paradigm.

#### **6.5. Key 5. Form a thinking space and be creative**

The main mission of creating a thinking space based on teamwork, innovations and stakeholder satisfaction is to create an efficient and technologically mature system. An example of this was demonstrated by the Ministry of Finance of Ukraine, which developed a conceptual scheme of creative model, forming the basis of the accepted approach based on the public finance system.

Making this key successful was achieved through:

- creation of a team and preparing it to changes;
- consolidation of strategic credibility of professional groups;
- operation on the basis of criteria for customer satisfaction;
- focusing of management system on perfection and competitiveness;
- using creative technology.

#### **6.6. Key 6. Carry out system reload**

As an example of this, a structure of a programme was developed by the authors. This structure consisted of three main blocks: the basis, projects (programs) and innovative mechanisms.

As an example, successful implementation of such large-scale reforms in public finance system of Ukraine created the need for rapid, high-quality and effective training of all staff involved in the public finance system. In response to this, the Virtual University of the Ministry of Finance was established. The Virtual University is successfully operating and currently more than 100 thousand public civil servants are training and taking the independent testing there.

One of the main principles which form strategically-important public confidence is transparency of public finance system (Azarov, 2012). Based on this principle, systems of education and information technologies developed for stakeholders in the public sector of Ukraine have the function of control over allocation and spending of budgetary funds at all administration levels, down to individual level. The system «Transparent Budget» provides full access to the stakeholders of public finance system of Ukraine.

Making this key successful was achieved through:

- development of a reload program based on the philosophy of life cycle;
- practicing innovative mechanisms for development programs;
- educating and training of stakeholders;
- implementation of the program with focus on success.

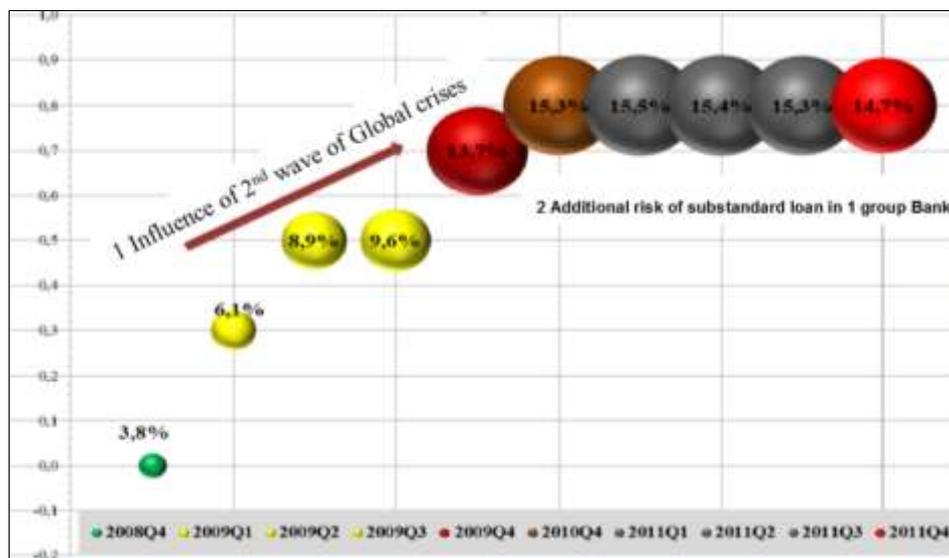
### **6.7. Key 7. Create and develop knowledge and perfection Centre**

Again, using Virtual University as an example, the main tasks of “knowledge and perfection centre” was to provide training and independent testing of all interested parties on public finance system reload. The knowledge accumulated about the activities of departments, their functions and tasks was presented in the form of creative pattern form and templates about development of technological maturity of the public finance system in Ukraine. To support the centre a large number of textbooks and academic commentaries in the field of public finance were prepared.

Making this key successful was achieved through:

- providing training and independent testing of all stakeholders within the Virtual University;
- accumulating of formal and structured knowledge about the activities of departments, functions and tasks in creative pattern form;
- developing technological maturity of the public finance system.
- Mechanisms are divided into two types:
  1. By disturbance, caused by the influence of the environment;
  2. By deviation, as a response to external environment threats to the model.

In the process of implementation of development programs there is a non-linear nature of changes (threats, challenges, and risks). They are concentrated in the neighbourhood of bifurcation points. As example, dynamic diagram of threats by “toxic loans in banking sector” of Ukraine is presented in fig. 4. This diagram is built based on the system of external and internal indicators (Yaroshenko, 2012).



**Fig. 4.** Bubble diagram of credit threats in the banking loan sector

In fig. 4, a vertical axe is the probability of bubble explosion. Horizontal axe is the time. The sizes of bubbles represent the level of damage to the economy. The colours of bubbles represent the level of turbulence after bubble explosion.

## 7. Testing of alternative threats in management scenarios

Common scenarios of threat management are formed using the following steps.

1. Pareto area is set up and consists of a set of bubbles. Each bubble is characterized by three parameters:

- a. risk of explosion
- b. size of damage
- c. consequence of the explosion (a possible chain reaction, turbulence in the environment).

Dynamic behaviour of bubbles is considered, including the relationship between them in the current time and a number of scenarios for each bubble until the next bifurcation point (checkpoint). In addition, a set of scenarios is considered - those that would reduce the risk of explosion, the size of damage and consequences.

3. A model of full immune reaction to Pareto area threat is formed taking into account the interactions between bubbles.

For each scenario the following should be determined:

- the content of each scenario;
- parameters of the end point including risk, size and consequence;

- 
- a recurrence scheme of movement in the project to take into account the movement by all bubbles.

## **8. Immunology of projects**

The main objective of this model is to develop a strategy for management of external threats based on immune mechanisms.

The basis of mechanisms developed by the authors is formed by forming an analogy with the immune mechanisms of living organisms.

Immune mechanisms should lead to immune reaction (reaction to a stimulus). As an example, using this analogy, a situation can be considered whereby there is a loss of capital at high-technology enterprise due to the wrong policy being applied and VAT not being refunded to it as a result. In such an instance it would be necessary to compensate these ‘missing’ funds through redistribution of funds from other activities or through loans.

The immune response can be developed through multi-level antibodies and such response is accompanied by changes.

When entering the market with a product which has an exhausted life cycle (delay of 7-10 years), the project may become unsuccessful and the best outcome of such project may be its earliest termination with minimal losses of resources.

The key parts of immune mechanism are:

1. Diagnosis of critical threats that belong to Pareto area;
2. Testing of alternative threat management scenarios (individual threats management scenario is tested first followed by being tested as part of a complex);
3. A unit of a full immune reaction formation to the Pareto area threat taking into account their interactions.

## **9. Conclusions.**

From the analyses presented the following can be presented:

- a systemic approach to definition of threats in high technology production project management allows to make conclusions on feasibility and relevance of using “immune mechanisms” in making decisions;
- formation of immune mechanisms within project management methodologies based on the analogy approaches can only occur after the steps of convergence and integration of threats and challenges in development programs of high technology enterprises.

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- use of methods for determining the degree of similarity between systems allows to choose a model of immune mechanism, and justify the relevance and feasibility of using analogy approaches for formation of effective project management methodologies.

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