

# **Interactive Innovative Tool for Early Diagnosis of Global Pre-Crisis Processes (based on measurement and assessment of the Virtual Intellectual Capital)**

*Prof. Vahanyan G., Vahanyan H., Ghazaryan M.*

## **Abstract**

**Purpose:** The paper aims to present the great importance and impact of the Virtual Intellectual Capital (VIC) in the frameworks of digital economics, e-governance and business, e-trading and commerce, virtual organizations and enterprises, and Information Communication Technologies (ICT) development. These conditions increase the importance of the measurement and assessment of the VIC.

**Design/methodology/approach:** The research findings are obtained through the method of comparative analysis of the complex models of the VIC. The features are studied through measuring and assessing the VIC parameters of virtual representations on the Internet. The data are complemented through virtual cluster analysis (VCA), a multidimensional statistical procedure that collects data containing information on facility selection. Three cluster groups are used in the study: the clusters of the TNCs and their virtual representations; the clusters of the network of the leading innovation centres and their virtual representations; the clusters of the leading universities and their virtual representations.

**Findings:** The paper establishes the research findings of the growth forecasts of the IC clusters in the World, Russian and Armenian economic processes. This is extremely important to ensuring sustainable growth of the country's competitiveness, economy and general welfare. The paper proposes a new model of the Virtual National or Transnational Intellectual Capital (VNTIC). The VNTIC model presents three general components: virtual representations of universities, innovation centre networks and transnational corporations in global networks. The research findings show that the Interactive Innovative Tools (IIT) can be used for early diagnosis of the World economic and financial processes.

**Originality/value:** The authors developed for the first time the Interactive Innovative Tools for measuring and assessing the three Intellectual Capital Components. The paper presents a new approach and a more reliable tool for short-term forecasting at global and national levels based on QI ranking of the VIC clusters of the commercial enterprises, universities and networks of innovation centres.

---

**Article Type:** Research Paper

**Keywords:** Virtual Intellectual Capital, Innovative tool for early diagnosis, IC clusters, Global pre-crisis processes, Global Economy, Measuring and assessing the VIC

---

## **Introduction**

With the increase in the complexity and scales of the governed entities of Megaeconomy, the emergence of new technological processes and services, continuously increases the volume of information and knowledge essential for forecasting, analyzing, planning, measuring, assessing and making regulatory or corrective decisions. International organizations and financial institutions try to present short-term forecasts of the progression of the world economy, not always providing reliable reasoning of the causes and effects of the crises. Their proposals are sometimes subjective and are provided to managers, government officials, business managers, business owners and other stakeholders as a whole in a non-comprehensive language, which causes distrust and does not facilitate the mobilization of all possible resources. The necessity for

practical integration of explicit and tacit knowledge, the advantages of novel methods and models, forecasting technologies with the benefits of computer graphic language in the tasks of Megaeconomy management is apparent and objective. Under these conditions, the development of an applicable and accessible tool for modeling and forecasting Megaeconomy becomes an urgent task.

The twenty-first century faces the great importance and impact of the Virtual Intellectual Capital (VIC) in the frameworks of digital economics, e-governance and business, e-trading and commerce, virtual organizations and enterprises, and Information Communication Technologies (ICT) development. These conditions increase the importance of measuring and assessing the VIC. The authors establish a new model of the Virtual National or Transnational Intellectual Capital (VNTIC). The VNTIC model presents three general components: virtual representations of universities, innovation centre networks and transnational corporations in global networks. The authors developed for the first time the Interactive Innovative Tools (IIT) for measuring and assessing the three Intellectual Capital Components. The paper establishes the research findings of the growth forecasts of the IC clusters in the World, Russian and Armenian economic processes. This is extremely important to ensuring sustainable growth of the country's competitiveness, sustainable economic growth and general welfare. A new approach and a more reliable tool for short-term forecasting at global and national levels is the forecasting based on QI ranking of the VIC clusters of commercial enterprises, universities and networks of innovation centres. The research findings show that the IIT can be used for early diagnosis of the World economic and financial processes.

The results of the study (**Vahanyan, 2006-2007**) of the innovative model of the VIC cognitive cluster allows to reveal the patterns of progression of global and national intellectual capitals. The portrait models of the VIC indices can serve as a new visual, simple and applicable tool for identifying and highlighting the features of the progression of the world and national economies. They allow forecasting pre-crisis situations, for example, specific to global crises in 2008 and 2016, and also anticipating their effects at national level.

A new VNTIC model (see **Figure 1**) as a virtual IC cluster is proposed. The VNTIC model presents three general components: virtual representations of the world universities, the innovation centre networks and the transnational corporations in global networks. A corresponding system of effective indicators has been developed, which allows measuring, assessing and identifying the patterns of the progression. Using the proposed method based on the VIC portrait model, the global crises in 2008-2016 were forecasted, identified and interpreted; they are displayed on the trajectories of the VIC indicators of transnational corporations with points of "breakdown" or "decrease". The proposed IIT for early diagnosis of crises allows identifying factors that disrupt the stability of the progression of global and national economies in the context of social-market relations.

Using the VNTIC model as a methodological forecasting tool, the authors present the cluster model for economic growth based on the VNTIC (see **Figure 2**). The following four interrelated components form the cluster model for economic growth: 1) Universities as knowledge generators; 2) innovation centre networks transforming knowledge into technology, industrial designs and services; 3) commercial organizations manufacturing products and providing related services for mass market, ensuring added value based on knowledge, technology, industrial designs and new services; 4) considerable amount of added value is transformed into investments, which play the role of engine for economic growth.

The article describes a new method for studying Megaeconomy based on the method of cluster analysis of three types of VIC conceptual models (the VIC portrait models of commercial, educational and innovative organizations and enterprises). The VIC is rated based on the indicators and features of the clusters of electronic representations of particular organizations and enter-

prises on global networks (Google and Yandex). The tool not only illustrates the results of impacts on an administered facility (Megaconomy), but also conveys new knowledge that is not directly identified in the traditional economic description and interpretation and remains tacit. A feature of the tool in the form of visual graphic portrait models is the ability to transmit a complex of dynamic interrelated properties of progression processes in a way that is directly associated with these properties. In addition, the triads of portrait models allow reflecting the processes of solving global and national management problems, taking into account and highlighting the specific conditions at individual stages of the process. All these features forecast the practical significance of the methods for interactive modeling of Megaconomy, the progression of which is explored on models of IC cluster management with the use of strategic matrices and situational maps of the interrelated VIC portrait modules, which both reflect and model the processes under the study.

## Methodology

The modern global economy and the development of its network form depend on the formation rates of the global IC as the main factor of sustainable, innovative growth of competitiveness among national economies based on knowledge (knowledge-intensive Megaconomy). The IC (especially the VIC of the global network, the global network economy) in the production of knowledge-intensive commodities and services is becoming the main factor in increasing added value, which plays a key role in ensuring the general welfare, democratization and liberalization of governance.

The results of the study of the features of global economic progression are obtained through implementation of the method of comparative analysis of the complex models of the VIC. The VIC conceptual cognitive model is a system of three interrelated clusters of VIC organizations and enterprises. Their features are studied through measuring and assessing the VIC parameters of virtual representations on the Internet. Among them are transnational corporations (TNCs), networks of the leading innovation centres (in Europe) and the leading world universities. The formation and development of the global IC depends on them in global and national economic spaces.

The cluster models, reflecting the progression of the global economy (Megaconomy), represent triads of the IC portraits. The IC portraits are represented as triad indicators (diagrams and graphs) of the VIC. The VIC components in progression are studied through measuring and assessing a system of effective (balanced) indicators that allow studying complex models which cannot be formalized by using traditional methods. The processes that characterize the progression of the global economy are represented through visual portrait graphic models – the triad diagrams. The purpose of the developed tool is to facilitate the forecasting and identifying the characteristic symptoms, features, properties and patterns of progression of the complex system (the world economy) in the context of its models (IC component modules) as a triad of the interconnected VIC component modules. The current condition is analyzed on a panel device for global management. Based on the results of the data comparison, various hypotheses are generated, forecast scenarios are proposed, negative trends are anticipated, and management decisions are selected to ensure effective impact measures (activities, projects and programs) that minimize or eliminate negative phenomena, thus preventing them from growing into crises.

Virtual cluster analysis (VCA) in management is a multidimensional statistical procedure that collects data containing information on facility selection. Three cluster groups are used in the study: the first group includes clusters of the TNCs and their virtual representations; the second group consists of the clusters of the network of the leading innovation centres and their virtual representations; the third group comprises clusters of the leading universities and their virtual representations (**Vahanyan and Vahanyan, 2016; Vahanyan, 2009**).

## Megaclusters

The study uses 3 virtual commercial mega clusters with a different number of facilities: the global cluster of 28 transnational corporations (see **Figure 3**); the Russian national cluster of 20 leading commercial organizations (see **Figure 5**); the Armenian national cluster of 78 large commercial enterprises in Armenia (see **Figure 8**). Moreover, two innovative mega clusters are formed: the European network of innovation centres comprising 182 facilities (see **Figure 4**); the national mega cluster (the Russian network of innovation centres) comprising 63 facilities, including the centres in Moldova and Belarus and 3 educational mega clusters: 194 leading universities of the world (see **Figure 10**), 57 leading Russian universities (see **Figure 10**), and 38 leading universities in Armenia (see **Figure 10**).

Based on the data obtained from the mega cluster study, additional 3 gega clusters are formed: the transnational gega cluster (see **Figure 9**), which includes 126 facilities (the leading World, Russian and Armenian commercial organizations); the transnational gega cluster (see **Figure 7**), which includes 245 facilities (the networks of innovation centres in the world [Europe] and Russia); the educational or university gega cluster (see **Figure 10**), which includes 289 facilities (the leading universities in the world, in Russia and Armenia).

For a profound study and interpretation of the computed data, 3 combined clusters are developed: the global gega cluster comprising 404 facilities (commercial and innovative organizations, as well as world universities, see **Figure 4**); the Russian national gega cluster comprising 140 facilities (commercial and innovative organizations, as well as Russian universities, see **Figure 6**); the Armenian national gega cluster comprising 116 facilities (commercial organizations, as well as higher educational institutions in Armenia, see **Figure 8**).

The methodology provides a high degree of similarity of the facilities within each cluster (mega cluster and gega cluster). Theoretically infinite number of clusters can be formed. However, it is the allotted clusters that give a general description of the features of the IC (VIC) progression as an integrated system. Thus, the triad of VIC clusters model the action of an IC mega cluster and, accordingly, the three VIC mega clusters model the action of the IC gega cluster of the global economy. Of particular interest are the facilities that do not fit into any of the clusters (various international organizations, committees, expert communities, the IMF, the World Bank, the UN and others). However, their consideration is beyond the scope of this study. The authors use hierarchical (modular) clustering, which implies fragmenting large clusters into smaller ones. The result of the taxonomy is a hierarchical tree structure. Each facility (Megaconomy, global economy, national economy, Eurasian Economic Union, European Union, etc.) is characterized by listing all clusters to which it belongs to.

The methodology also implies the method of intellectual cognitive graphic analysis of virtual data – a virtual cognitive data mining, which is essential as a data analysis phase in developing a complete analytical solution. Graphic analysis is essential as it allows building graphic models (mega clusters) substantively based on the features of the cognitive conceptual graphic cluster, intuition (mental abilities, intelligence inherent to human vision), the accumulated experience, the synthesis of explicit and tacit knowledge, thus anticipating the progression trends, and validating the right decisions (**Vahanyan, 1991; Vahanyan and Vahanyan, 2005**). It is graphically easier for a researcher to identify groups of similar objects, to study their features and develop a particular model for each group in the form of a cognitive image, than to create a complex and expensive common model in a research laboratory for all data, which is inapplicable for managers. This technique is constantly used in marketing, allotting groups of customers, consumers, goods and developing an individual strategy for each of them.

The main thing in managing global and national economies is to prevent a disbalance in the formation and development of intellectual capital, a “collusion” between international parties,

transnational corporations and their owners with national, state, financial and banking structures and foundations.

The VNTIC model is used as a methodological forecasting tool. The following four interrelated components form the cluster model for economic growth: 1) Universities as knowledge generators; 2) innovation centre networks transforming knowledge into technology, industrial designs and services; 3) commercial organizations manufacturing products and providing related services for mass market, ensuring added value based on knowledge, technology, industrial designs and new services; 4) considerable amount of added value is transformed into investments, which play the role of engine for economic growth.

In terms of development of network or digital economics, e-governance and business, e-trading and commerce, the VNTICs are represented by simple and accessible virtual model clusters of the NTIC (virtual representations of universities, innovation networks and commercial organizations in global networks) component, which are affordable and accessible for visual reflection, measurement and assessment.

To study the human body, medicine uses three different approaches simultaneously: the study of brain and nervous system, the study of cardiovascular system and the study of gastrointestinal tract. The findings of the comprehensive study enable to diagnose more reliably and accurately the condition of a body and its development prospects in general. To perceive properties of an integer, one should know the properties and characteristics of its constituents. Thus, economic management implies that not knowing its features, advantages and disadvantages (both tangible and intangible assets) as a system, makes it impossible to increase its competitiveness. Using traditional approaches with indicators that are specific to tangible assets, the WB and IMF experts do not always consider the patterns of balanced development of intangible assets in their interactions (including tangible assets). The forecasts of international organizations gradually lack confidence.

The offered tools are widespread, accessible to all management levels on both national and supranational scales, to professionals and experts in the fields of social and economic forecasting, to investors, universities, innovation and commercial organizations, to government officials and public employees. The authors present below the results of the forecasts of the growth of World, Russian and Armenian Economies, which are formed based on the offered tool, compared with the forecasts of international organizations and national experts.

## **Forecasts of Global Economic Growth**

### ***Trends of Global Economy***

The portrait diagram triads, reflecting the progression of the components of the gega cluster of global economy, comprising mega clusters of the VICs of the TNCs, the European network of innovation centres and the leading universities of the world, present the results of the index indicators (QI) of the VIC from 2006 to 2016. The QI indices of the VIC are calculated using the method developed by the authors (**Vahanyan and Vahanyan, 2005; Vahanyan, 2008**). The analysis of the virtual gega cluster model (see **Figure 4**), consisting of a triad of cluster diagrams, revealed the following patterns:

1. On the modeling trajectories of the index (QI) progression of the portrait models of the VIC of the TNC gega cluster, characteristic points are observed indicating the early stages of the economic crises in 2008 and 2014. About two years prior to their development, the VIC indexes decrease and the graph points accelerate the deceleration. The beginning of the global crisis is indicated by negative trends in all three triad diagrams starting in 2006 and 2010 respectively.

**2.** The structure of the triad diagrams comprises three layers. The diagram, depicting the VIC indexes of the leading world universities, resides at the top layer. Within the VIC component triad, the VIC indices of the leading universities in the world have the highest values. The mid layer presents a diagram of the VIC indices of the TNCs. The lower layer shows the diagram of the VIC indices of the European Network of Innovation Centres (ENIC).

**3.** Throughout the study a total decrease in VIC indicators is identified. This characterizes low indicators of the global economy.

**4.** Global crises are accompanied by deceleration of the VIC index of universities; there is a decrease from 0.27 to 0.16. The index fluctuates around the average value. Similarly, the VIC index of the European network of innovation centres decelerates from 0.17 to 0.05. The VIC index in 12.2015 was approximately equal to the value typical for 10.2008. This indicates the threshold saturation of the IC of the ENIC. Thus, the process of formation and development of the IC of the ENIC decelerates and is soon suspended.

**5.** Throughout the crises, the VIC index of the TNCs (and, respectively, the IC of the TNCs) sustains stability. After the first crisis, it sharply grows after 2009, and then again decreases in 2010. After the first and the second crises, the VIC index of the TNCs shows a trend towards growth. In general, the index (QI) of TNCs increased from 0.14 (2006) to 0.16 (2015). After the crises, those TNCs benefit, which can be characterized as inertial systems that are more resistant to external impacts; they draw a part of the IC of the leading world universities, as well as part of the IC of the network of innovation centres. As a result, the IC of the universities and networks of innovation centres are decreasing, which is clearly shown in the diagrams of the VIC indices of the TNCs, universities and the network of innovation centres. However, the formed disbalance threatens stability, reduces the sustainability of the progression of the global IC and, consequently, the global economy.

**6.** After two global crises, an increased mobility of the IC components is observed. Migration of a part of the IC of universities and the network of innovation centres into the components of the IC of TNCs has led to the growth of the IC of the TNCs as a whole. Transnational corporations were able to overcome crises with the least wastes due to the increase of their IC (thus reducing the IC of universities and innovation centres). TNCs managed to restore the balance in a short time and to ensure the growth of the VIC index from 0.14 to 0.16.

**7.** IC plays the role of an “immune system”, a shield of safety, resilience, stability of TNCs to adverse external influences. The outflow of the IC from universities and the network of innovation centres (donors of the IC of the TNCs) reduces the level of the “immune system” of universities and innovation centres. Their resistance to external negative influences decreases. Restructuring the global IC temporarily supports the sustainability of the global economy. However, in case of the disturbance of equilibrium in the structure of global economy, changes are inevitable.

**8.** The three components of the global model of the IC are interrelated. To insure sustainability of the progression of global economy, the IC indicators should be balanced. It is necessary to constantly monitor the IC balance on portrait indicators, not allowing a mismatch in the development of its components. When diagnosing the factors that indicate pre-crisis situations, it is necessary, through the adoption of appropriate measures, to stimulate efforts ensuring the priority growth of the IC of universities and the network of innovation centres. This will allow minimizing the wastes after migration of their components into the IC of the TNCs. In order to suspend or slow down the migration pace, it is necessary to ensure that the IC of the TNCs are continuously supplied with “donor blood” and, at the same time, compensate for the damage done to donors – universities and innovative centres. The dominance of the IC of the TNCs in global scale can rise into a threat for global economy. The decrease of the IC level of the two components from the triad reduces the stability of the complex, leading to its destruction. Thus, the IC of the TNCs will stay lacking “donor blood” in case of new crises, which will have a destructive impact. Redistribution of the IC and property among the owners of TNCs on a global scale will take place. This will be accompanied by characteristic consequences, the deva-

luation of the exchange rates of national currencies, the fall in the cost of oil and gas, gold and other mineral resources.

9. In general, the growth or decrease in the level of the IC of the TNCs with sharp fluctuations beyond the permissible limits on the global control panel will allow forecasting negative processes in due course and preventing undesirable trends.

### **Ranking of the QI Clusters of the VIC of the TNCs, the European Network of Innovation Centres and World Leading Universities (results for 2016)**

The analysis of the dynamics of the ranking indicators of Arcaler QI of the VIC of the TNCs on the results for 2016 confirms the accuracy of the forecasts by the authors: *diverse stages of global financial crisis persist*. As compared with the ranking for 17.06.2016, the QI value of the VIC of the TNCs on 17.12.2016 decelerated from 0.17 to 0.14 (see **Figure 3**). Compared with the ranking for 10.06.2016, the average value of the QI of the VIC of the European network of innovation centres on 10.12.2016 decelerated from 0.044 to 0.038 (see **Figure 4**). Compared with the ranking for 13.06.2016, the average value of the QI of the VIC of world leading Universities on 13.12.2016 decelerated from 0.24 to 0.09 (see **Figure 4**).

The tendencies of deceleration of the QI of the VIC clusters of the TNCs, the European network of innovation centres and world leading Universities diagnose symptoms of crisis extension, the emergence of new risks and threats. Thus, the QI of the VIC of the European network of innovation centres fell from 0.178 to 0.038 since 2006 to 2016; the QI of the VIC of the TNCs for 2016 (0.14) tends to the absolute minimum registered in 2007 (0.13). The QI of the VIC of the world leading universities for 2016 (0.09) also tends to the absolute minimum of 2014 (0.091); for comparison, in 2007 the QI of the VIC of the world leading universities was equal to 0.275.

Comparison of the obtained indicators with the forecasts of the World Bank and other international organizations confirm the hypothesis: *ArcaLer (the QI of the VIC) is an innovative, vivid, secure and reliable tool for early diagnosis of global economic crises and mismatch of global social-economic processes (Vahanyan et al., 2015)*.

It's time to change the development strategy at all levels of governance and to start increasing investments in national IC. This is extremely crucial for ensuring sustainable global economic growth for general welfare.

### **The World Bank Forecasts**

In the "Global Economic Prospects 2017" report (**World Bank Group, 2017**) the World Bank deteriorated forecasts of global economic growth (0,1 percentage point) up to 2,7% and 2,9% in 2017 and 2018 respectively. Thus, the World Bank forecasted global economic growth up to 2,8% in 2017 and to 2,8% in 2018. In this regard, the World Bank lowered the forecast for global economic growth in 2016, projecting serious obstacles for emerging economies. Forecasts for 2018 are also deteriorated reaching 2,9%, 0,1 percentage point lower. The WB forecasts that global economic growth rates are expected to remain at 2,9% level in 2019. According to WB evaluation, global economy expanded by 2,3%, estimating it as the lowest pace for post-crisis period.

Forecasts for global economy are clouded by uncertainty about policy directions in the world leading countries. A protracted period of uncertainty could prolong the slow growth in investment that is holding back low, middle, and high income countries.

### **Forecasts of Economic Growth in Russia**

## ***Ranking of the QI Clusters of the VIC of the Leading Commercial Organizations in Russia, the European Network of Innovation Centres and Universities (results for 2016)***

The analysis of the ranking indicators of the QI of the VIC clusters of diverse organizations allowed the authors to identify extension of the current phase of Russian economic and fiscal crisis. Tendencies of deceleration of the QI of the VIC of the leading commercial organizations in Russia diagnose adverse state of Russian economy (see **Figure 6**). Nevertheless, Russian economy displays possible modest deceleration of crisis and symptoms of economic recovery.

Compared with the ranking on 16.06.2016, the average value of the QI of the VIC of the leading commercial organizations in Russia on 16.12.2016 lowered from 0.13 to 0.12 (see **Figure 5**). Compared with the ranking on 16.06.2016, the average value of the QI of the VIC of the network of Russian innovation centres (including centres in Belarus and Moldova) lowered from 0.158 to 0.144 by the end of 2016. Compared with the ranking on 02.06.2016, the average value of the QI of the VIC of the leading universities in Russia has accelerated from 0.26 to 0.29 (see **Figure 6**).

Tendencies of deceleration of crisis and its possible recovery symptoms are shown in Diagrams of the QI of the clusters of VIC of the leading commercial organizations in Russia, the network of innovation centres and leading universities by acceleration charts of the QI of the VIC of the leading universities in Russia, compared to fall of the QI of the VIC of the leading commercial organizations in Russia and the QI of the VIC of the network of innovation centres (see **Figure 6**).

However, instead of maintaining a positive trend, the Russian government is taking an inadequate solution: the expenses for the development program of the scientific-technological complex are reduced by 25 billion rubles. The expenses for scientific research will be reduced by 19 billion rubles.

Consumptions on development of the scientific-technological complex in 2017-2019 will be reduced by 25 billion rubles regarding to the values established for that period in the federal targeted program for development of the scientific-technological complex in 2014-2020. The comparative diagram (see **Figure 7**) shows that the QI of the VIC of the TNCs is higher than the QI of the VIC of the commercial organizations in Russia. This states that the level of competitiveness of the commercial organizations in Russia do not correspond to global standards yet. To accelerate their competitiveness, investments should be made in the IC of the leading commercial organizations in Russia, which requires fiscal investments in developing the scientific-technological complex.

The West and the US tend to decelerate Russian economic growth and to lower competitiveness of the leading commercial organizations in Russia. It should be mentioned, that sanctions affected deceleration of the QI of the VIC of the commercial organizations in Russia from 2014 to 2016. The QI of the VIC of the commercial organizations in Russia fell from 0.21 to 0.12 (nearly twice). This is the lowest indicator for 2006-2016.

Despite deceleration of growth, value of the QI of the VIC of the network of innovation centres picked up from 0.08 (in 2007) to 0.144, rising nearly twice. Value of the QI of the VIC of leading universities in Russia decelerated from 0.33 (in 2007) to 0.26, which is inadmissible. The QI of the VIC of the Russian network of innovation centres is higher than the QI of the VIC of the European network of innovation centres (see **Figures 18, 20 and 22**). These features and advantages were not considered by the Government while making strategic decisions. In case values of the QI of the VIC of the Russian network of innovation centres and commercial organizations (see **Figures 18 and 20**) keep on decelerating and reach the accessible limits, the future investments into development of the scientific-technological complex and education will not provide the desired effect. While making strategic decisions, the Russian Government needs complex, multi-faceted approach based on the data on managing national intellectual capital.

The growth driver of Russia is the balanced development of national intellectual capital. It is high time to start increasing investments in the IC by anticipatory growth of investments in the leading universities in Russia and development of the Russian innovation centre network. This is extremely important to ensuring growth of the country's competitiveness, sustainable economic growth and general welfare.

## Forecasts of Economic Growth in Armenia

### *Ranking of the QI Clusters of the VIC of the Leading Commercial Organizations and Universities in Armenia (results for 2016)*

Tendencies of crisis intensification in Armenian economy are visualized in the diagram showing the QI of the VIC clusters of the leading commercial organizations and universities (see **Figure 6**). The QI of the VIC of universities in Armenia decelerated abruptly from 0.17 (in 06.2016) to 0.1 (by the end of 2016), resulted in deceleration of the QI of the VIC of commercial organizations from 0.13 (in 05.2016) to 0.1 (in 11.2016). An unsustainable character of development of the QI of the VIC of Armenian commercial organizations and leading universities is observed (see **Figure 8**).

The QI of the VIC of Armenian commercial organizations is significantly lower than the QI of the VIC of Russian TNC and leading commercial organizations (see **Figure 9**). The level of competitiveness of the country's economy is far from the desired indicator. Analysis of the QI of the VIC trajectory (see **Figure 7**) shows that Armenian economic growth depends on global and Russian economic growth.

The Armenian Government did not manage to decrease the level of this dependency. New threats and risks have arisen. All this decelerates the level of Armenian economic security.

Analysis of the trajectory of the QI of the VIC clusters (see **Figure 9**) shows that Armenian economic growth is mostly affected by growth of the QI of the VIC of leading universities. For this purpose, investments in higher education are needed to ensure its growth to at least the level of the QI of the VIC of the leading universities in Russia.

It should be mentioned, that in 2008-2009 the QI of the VIC of universities in Armenia outpaced the QI of the VIC of universities in Russia. Nevertheless, while marking the growth of the QI of the VIC of Russian universities in Armenia for 2015-2016, decrease of the QI of the VIC of universities is observed.

Large investments are needed in forming and developing an innovation infrastructure in Armenia, in scientific-pedagogical training in the RA. Armenia can resist the threats if having the concept of anticipatory growth and effective management by developing the national IC as the basis of the development strategy (**Vahanyan et al., 2016**).

## Concluding Remarks

**1.** The comparative analysis of the dynamics of the VIC indicators of the network of the clusters of the TNCs and the leading Russian and Armenian commercial enterprises shows that the cluster of the leading Russian commercial organizations has the greatest growth potential.

**2.** The analysis of the dynamics of the VIC indicators of the network of the clusters of the leading universities in the world, in Russia and Armenia shows that the leading growth potentials are held by the leading Russian universities. It is crucial to invest in balanced growth of the IC cluster of Russian universities for the success of the IC cluster of the EAEU.

**3.** The analysis of the dynamics of the VIC indicators of the clusters of the European and Russian networks of innovation centres shows that the cluster of the Russian network of

innovation centres possesses the greatest growth potential. It is necessary to ensure the growth of the IC cluster of the Russian innovation centres.

4. The synergistic effect can be provided by the strengthening of Russia's national IC in the fields of higher education (universities), leading commercial organizations and innovative networks. Effective management of the formation and development of a mega cluster comprising the clusters of the national IC of the EAEU member countries (especially Russia) will ensure development breakthrough in the short term. It is necessary to ensure a balanced growth of the cluster model of the Russian IC.

5. It is expedient to develop and implement the concept of growth outpace of the IC mega cluster of the EAEU, based on the national clusters of the IC. It is suggested to create a cluster network of UNIDO Centres for Innovative and Industrial Cooperation in the EAEU member countries.

## Afterword

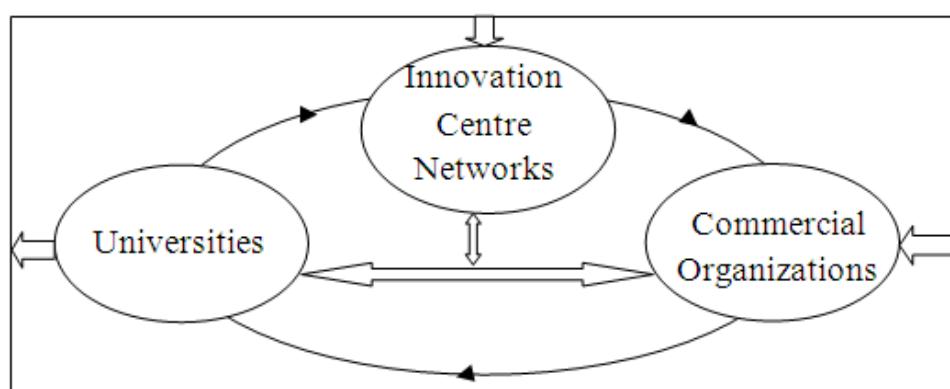
Even short-term forecasts of the World Bank and other international organizations and experts are not always objective and are usually regularly updated. A new approach and a more reliable tool for short-term forecasting at global and national levels are required. One of these new IITs is the forecasting based on the ranking of the QI of the VIC clusters of commercial organizations, universities and networks of innovation centres. The Russian network of innovation centres has a considerable potential for Russian economic growth, compared with that of the European which has practically exhausted its resources. Much more investments will be required to ensure the growth of intellectual capital of the European network than that of Russian.

A competent management will allow the Russian network of innovation centres, along with the innovation centres of the EAEU countries, to become a locomotive for formation and development of the EAEU IC. This will ensure growth of competitiveness of the EAEU.

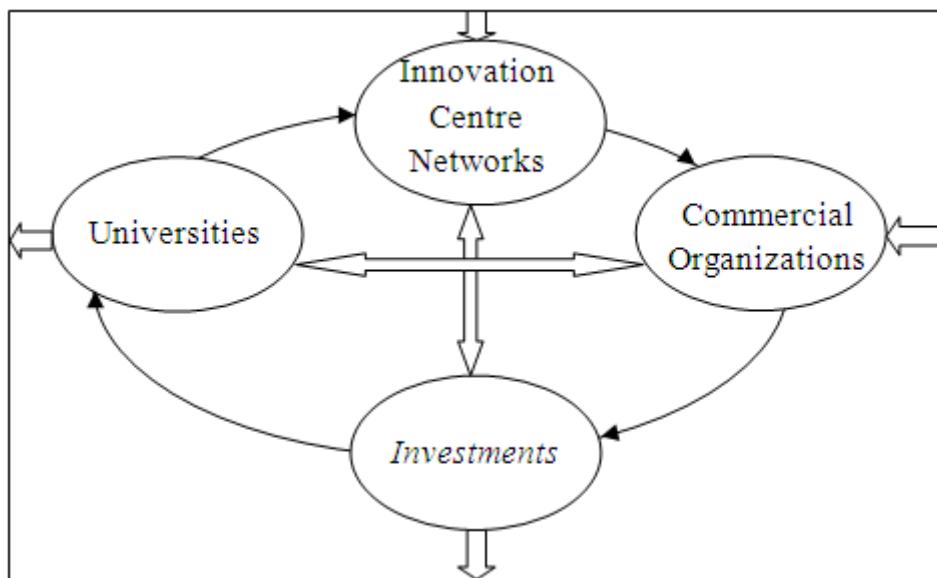
An indisputable success will be achieved through a thorough coordination of the policy in the field of innovation management for forming and developing the national IC. The developers of economic policy in the EAEC member countries should consider the highest effective, balanced use of positive effects of innovation activities in national economies.

Innovations in management of national intellectual capital require continuous investments. Before the crisis in 2009 the world R&D expenditures expanded by about 7% a year. The data shows that R&D expenditures around the world expanded by only 4%. The EAEC member countries registered two times lower indicators. Independent experts project up to 3% growth of R&D expenditures around the world in 2017. Thus, it cannot be assured that the global crisis will be successfully overcome.

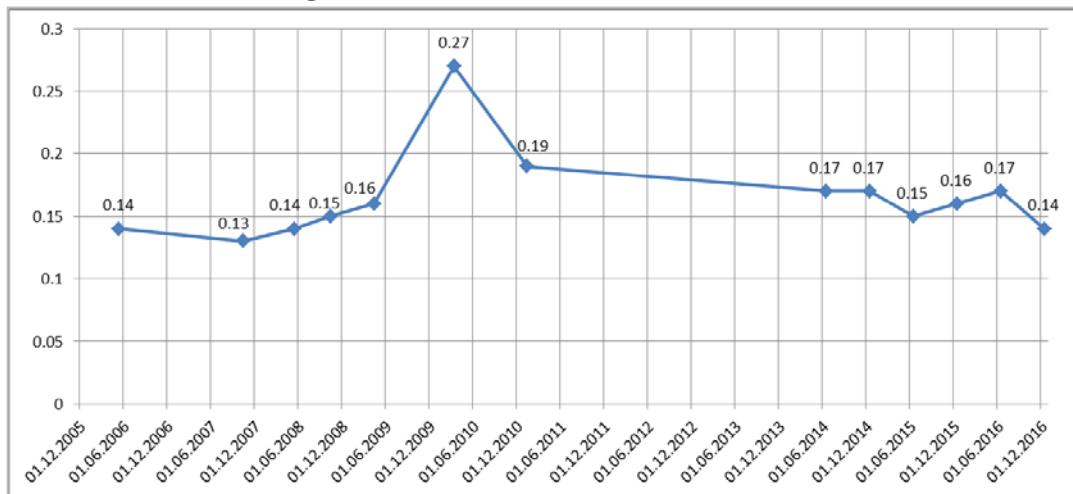
**Figure 1.** The three general components of the VNTIC model: virtual representations of universities, innovation centre networks and transnational corporations in global networks



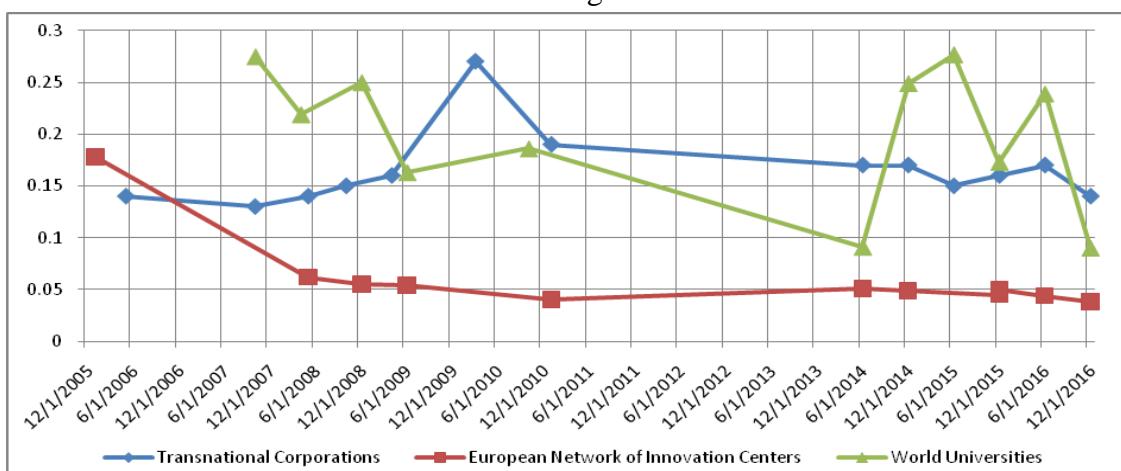
**Figure 2.** Cluster model for economic growth based on the VNTIC



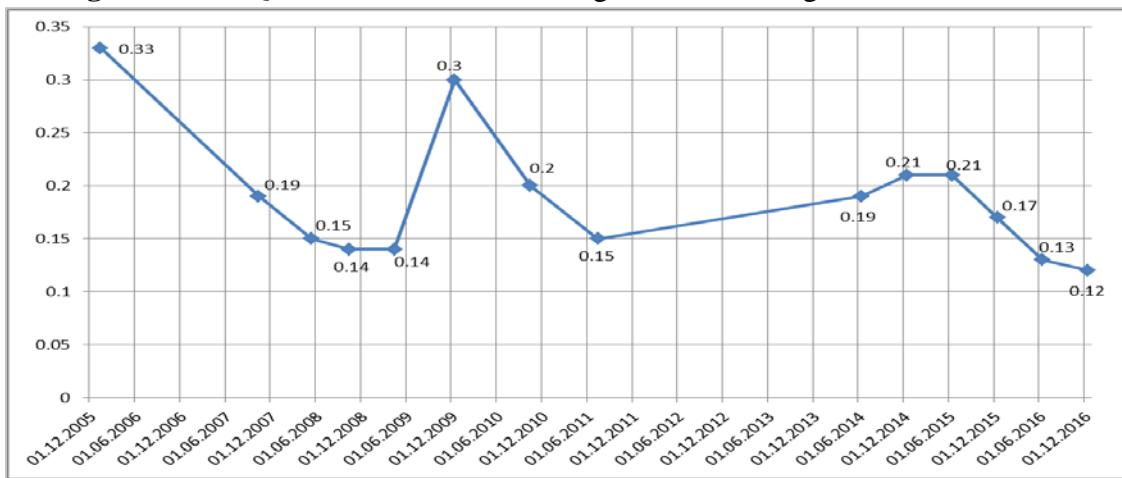
**Figure 3.** The QI of the VIC of the TNCs



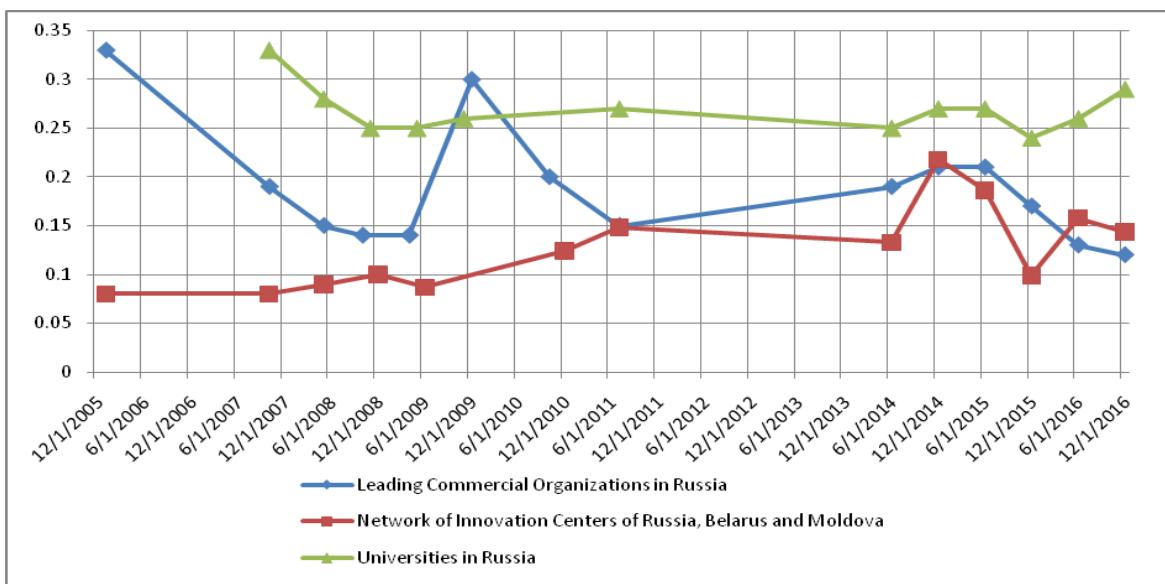
**Figure 4.** The QI of the VIC of the TNC clusters, the European network of innovation centres and world leading universities



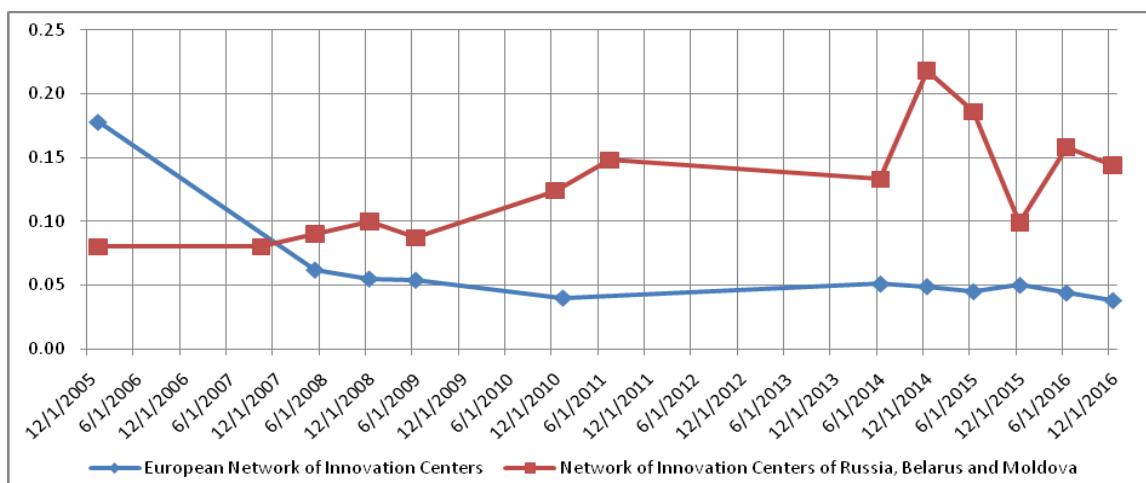
**Figure 5.** The QI of the VIC of the leading commercial organizations in Russia



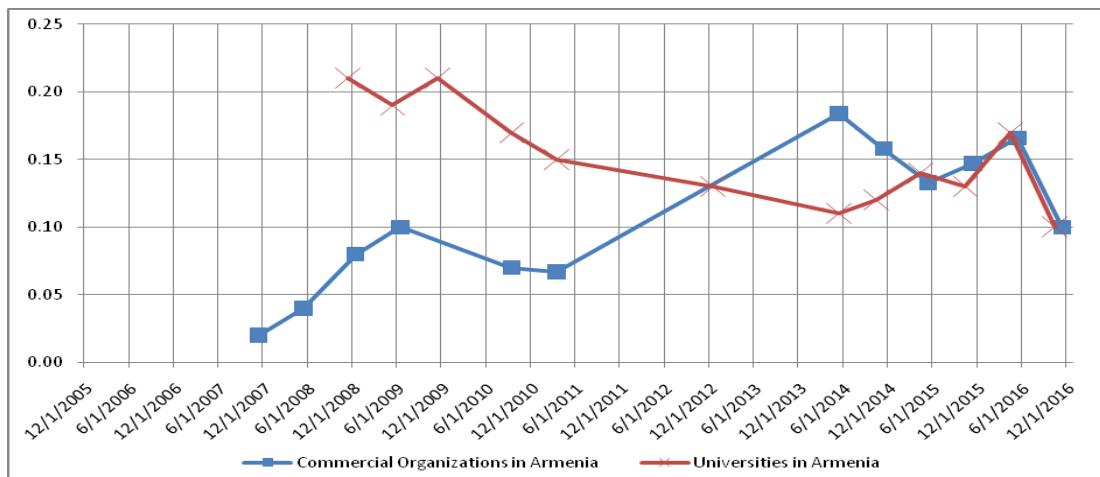
**Figure 6.** The QI of the VIC cluster of the leading Russian commercial organizations, the network of innovation centres and universities



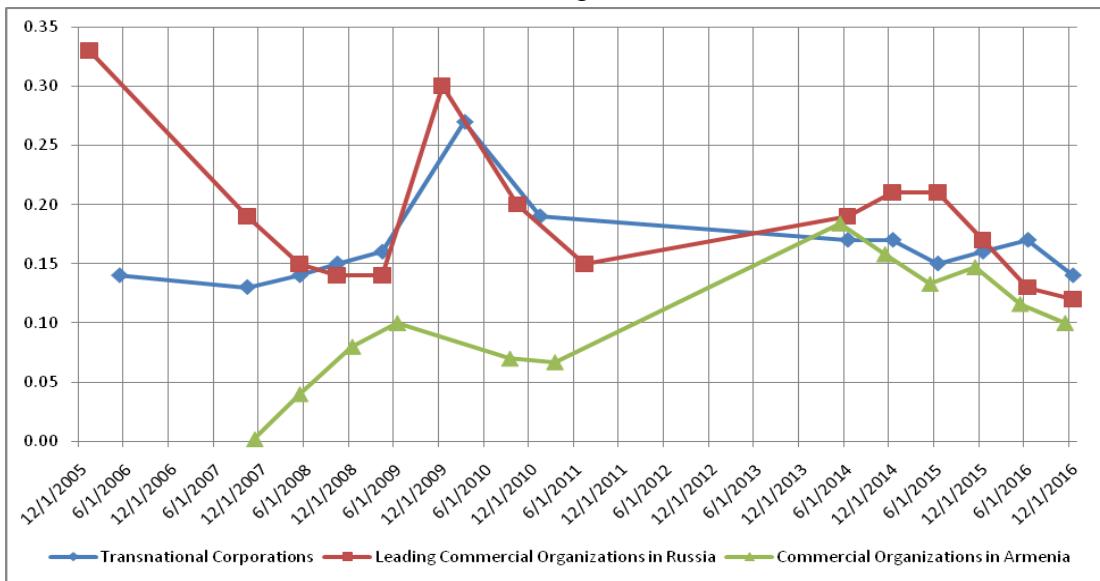
**Figure 7.** The QI of the VIC of the clusters of the European and Russian networks of innovation centres



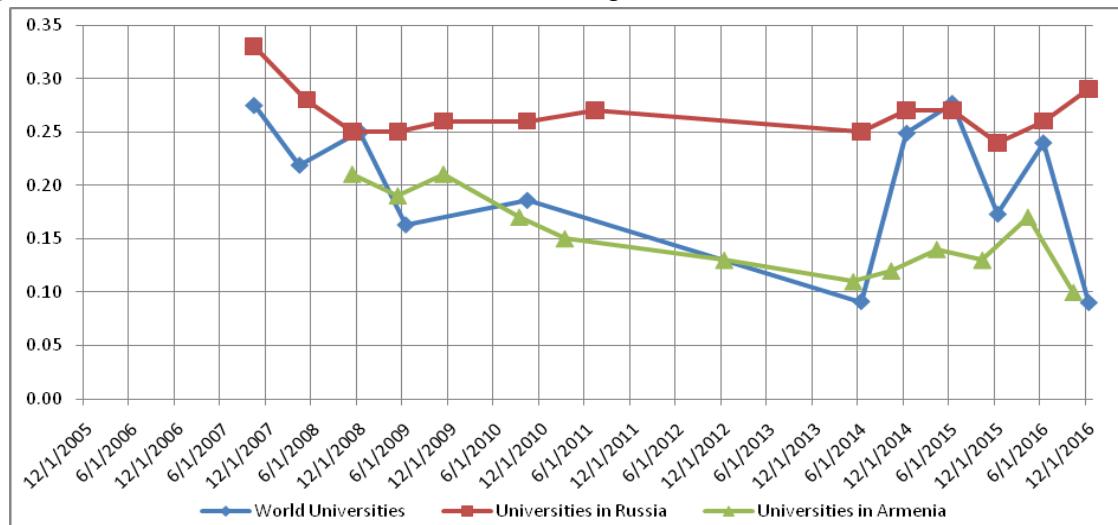
**Figure 8.** The QI of the VIC clusters of the leading Armenian commercial organizations and universities



**Figure 9.** The QI of the VIC of the TNC clusters of the leading Armenian and Russian commercial organizations



**Figure 10.** The QI of the VIC cluster of the leading world, Russian and Armenian universities



## References

1. Vahanyan, G. and Vahanyan, H. (2016), “Winning with the help of global innovations (on the example of Russia and other EAEU member countries)” in **Modernization of Russia: Priorities, Challenges, Solutions proceedings of the XVI International Scientific Conference, Moscow, 20-21 December, 2016**, Russian Academy of Sciences, Institute of Scientific Information on Social Sciences of the Russian Academy of Sciences, INION RAN, Moscow, available at:[http://ukros.ru/wp-content/uploads/2016/12/ваганян\\_ваганян.doc](http://ukros.ru/wp-content/uploads/2016/12/ваганян_ваганян.doc) (accessed 07 April 2017).
2. Vahanyan, H.G. (2016), **Management of the formation and development of intellectual capital (concept, technology, systems engineering)**, Monograph, Megaprint, Yerevan, 236 p.
3. Vahanyan, G., Vahanyan, H. and Tumyan, L. (2016), “Comparative analysis of the national intellectual capital of the BRICS countries as a key factor in the growth of the quality of public administration and competitiveness” in **BRICS countries: development strategies and mechanisms for interaction and cooperation in a changing world 2015 proceedings of the I International Scientific and Practical Conference in Moscow, 2-3 November, 2015**, INION RAN, Moscow, 2016, pp. 218-221.
4. Vahanyan, G.A. and Vahanyan, H.G. (2016), “Key problems of Russia in inefficient constitutional management”, **Yearbook “Russia: Development Trends and Prospects”**, Vol. 1, Russian Academy of Sciences, INION RAN, Moscow.
5. Vahanyan, G. and Vahanyan, H. (2016), “Patterns of world economy and cognitive models of the clusters of virtual intellectual capital”, **Yearbook “Russia: Development Trends and Prospects”**, Vol. 2, Russian Academy of Sciences, INION RAN, Moscow.
6. Vahanyan, G.A., Vahanyan, H.G. and Ghazaryan, M.E. (2015), “Early diagnosis of global pre-crisis situations”, available at: <http://www.iatp.am/news/rating/rating-2015.pdf> (accessed 29 July 2015).
7. Vahanyan, G.A. and Vahanyan H.G. (2014), “The concept of interactive management of intellectual capital of the Eurasian Economic Union as a key factor in the growth of competitiveness and modernization” in **Modernization of Russia: Key Problems and Solutions proceedings of the XV International Scientific Conference in Moscow, 18-19 December, 2014**, INION RAN, Moscow.
8. Vahanyan, G.A. and Vahanyan, H.G. (2011), “The strategy of cognitive public management or how to transform capacities into competence” in **Situational Centres - 2011 (situational centres and “electronic government”) proceedings of the Scientific and Practical Conference in Moscow, 26-27 April, 2011**, Russian Academy of Public Service under the RF President, Moscow.
9. Vahanyan, H.G. (2009), “A Virtual Tool for Intellectual Capital Management” in **proceedings of the European Conference on Intellectual Capital, Haarlem, the Netherlands, 28-29 April, 2009**.
10. Vahanyan, G.A. (2009), “Strategic analysis of virtual intellectual capital and indicators of knowledge economy in the Situation Centre (not traditional capture of knowledge)” in **Situation Centres – 2009 (modern information and analytical technologies for decision making) proceedings of the Scientific and Practical Conference in Moscow, 14-15 April, 2009, RAPA**.
11. Vahanyan, G.A. (2008), “Global financial crisis, measurement and evaluation of intellectual capital of the leading commercial and innovative organizations, educational institutions in the world and in Russia” in **Russia: Key Problems and Solutions proceedings of the IX International Scientific Conference, Moscow, Russia, 11-12 December, 2008**, INION RAN.
12. Vahanyan, H.G. (2008), “Tool for measuring and evaluating the intellectual capital of Russian organizations in network economy”, **Proceedings of the Federal Service for Intellectual Property, Patents and Trademarks, RSIIP**.

13. Vahanyan, G.A. (2007), “Reducing the quality of public administration is a threat to national security (on the example of Armenia)”, **“Public Service” Scientific and Political Journal**, Russian Academy of Public Service under the RF President, Vol. 4, No. 48.
14. Vahanyan, H.G. (2007), “Management of intellectual capital as an effective instrument of strategic management in Russia through knowledge economy”, **Creative Economy**, No. 5, 6, 7.
15. Vahanyan, H.G. (2007), “Methodology of efficiency assessment in intellectual capital”, **Creative Economy**, No. 9.
16. Vahanyan, H.G. (2007), “Refined estimation of intellectual capital based on Tobin's q and the methodology for efficiency assessing in intellectual capital”, **Russian Entrepreneurship**, No. 11.
17. Vahanyan, H.G. and Gaponenko, A.L. (2007), “Comparative analysis of indicators of economies based on knowledge, formed in the US, Europe and Russia”, **“Europe: Transition to the Knowledge Society?” proceedings of the Actual Problems in Europe**, No. 2.
18. Vahanyan, H.G. (2006-2007), “The tool of innovation policy in the economy based on knowledge (to the management of intellectual capital of Russian and European innovation centres)”, Arcaler, available at: [http://www.iatp.am/vahanyan/articles/ruseurop\\_new.pdf](http://www.iatp.am/vahanyan/articles/ruseurop_new.pdf) (accessed 04 May 2017).
19. Vahanyan, H.G., Vahanyan, G.A. and Bleyan, V.Yu. (2006), “Methods for rating determination and assessment of intellectual capital of the leading Russian innovation universities”, **Journal of Telecommunications and Informatization of Education**, Vol. 6, No. 37.
20. Vahanyan, G.A. (2006), “Intellectual capital: investments in the future”, **Cnews analyst, Survey “IT in National Projects”**, **Education in the Information Society**, Moscow, Russia.
21. Vahanyan, G.A. (2006), “Russian universities - who is better?”, **Cnews analyst, Survey “IT in national projects”**, **Education in the Information Society**, Moscow, Russia.
22. Vahanyan, G.A. (2006), “Where is Russian intellectual capital concentrated?”, **Cnews analyst, Survey “IT in national projects”**, **Education in the Information Society**, Moscow, Russia.
23. Vahanyan, G.A. and Vahanyan, H.G. (2005), **Virtual technologies of management (systems engineering of electronic control)**, Russian Academy of Public Service under the RF President, Russian-Armenian (Slavonic) State University, Monograph, Njar, Yerevan.
24. Vahanyan, G.A. and Bleyan V.Yu. (2005), **Information technologies in legal activities (in the public service system)**, Monograph, Njar, Yerevan, 176 p.
25. Vahanyan, G.A. (2004), “Systems engineering of democratization management. Systems engineering of construction”, in Gusakov, A.A. (Ed.), **Encyclopedic dictionary, II revised and enlarged edition**, International Engineering Academy, International Academy of Sciences, Moscow State University of Civil Engineering, Institute of System Analysis of RAS, Moscow.
26. Vahanyan, G.A. (2004), “Systems engineering of social and economic processes. Systems engineering of construction”, in Gusakov, A.A. (Ed.), **Encyclopedic dictionary, II revised and enlarged edition**, International Engineering Academy, International Academy of Sciences, Moscow State University of Civil Engineering, Institute of System Analysis of RAS, Moscow.
27. Gusakov, A.A., Vahanyan, G.A. et al. (1991), **Aerospace Informatics in the management and organization of large-scale construction**, Monograph, Hayastan, Yerevan.
28. Vahanyan, G.A. (1991), **Methodology of the development and use of dialog graphic models in the management of social and economic processes**, abstract of the doctoral dissertation, Academy of Social Sciences under the CC CPSU, Moscow.
29. Vahanyan, G.A. (1985), **Computer graphics in management**, Monograph, Hayastan, Yerevan.
30. World Bank Group (2017), “Global Economic Prospects: Weak Investment in Uncertain Times”, available at:<https://openknowledge.worldbank.org/bitstream/handle/10986/25823-9781464810169.pdf> (accessed 23 May 2017).