Creating Supply Chain Management Algorithm for University Integration in the National Innovation System

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Abstract- The current development trend, ensuring the welfare of the state, is in constant connection with the activity of innovation. Under the influence of sophisticated and innovative processes, the concept of the national innovation system based on the macroeconomic level is steady in general. Numerous elements are seen in the conjugation of the national innovation system scale, among which higher education institutions and their scientific and innovative potential take their place. However, the reverse side is inequality in the levels of university integration, which introduces a discrepancy between the degree of their effectiveness as the elements of the national innovation system. So it becomes urgent to have a specific set of steps to improve the level of university integration. The process of integration level increase must be governed necessarily by the principles of suitable integration condition supply chain management, where it is possible to justify waiting by the creation of a supply chain management algorithm for university integration in the national innovation system. The result of such an algorithm application is the obtaining of a visual set of steps by a user to ensure the process of managerial decision making and implementation to improve the level of university integration in the national innovation system. The increase of university integration will directly enhance its interaction with other elements of NIS, and therefore will increase its contribution to the national economic development, and other priority areas of the state.

Keywords- *Innovation, National innovation system, University integration, Supply chain management, Decision-Making algorithm.*

1. Introduction

In the modern developing world, characterized by the processes of globalization, the basis of a state economic well-being development is innovative activity. In this regard, the notion of the national innovation system (NIS), which includes economic entities and institutions, whose interaction is aimed at the creation and the use of innovative knowledge, has gained a wide acceptance. An important role is played by the process of integration strengthening, including the strengthening of university integration in NIS, which contain a great potential to carry out research and innovation development. However, the fact that the decision-making process is central in any system, remains unchanged. The provision and the support of this process at all levels is possible by an action algorithm application containing a set of steps to achieve a goal. In general, an algorithm is a formal prescription to perform a precisely defined sequence of actions aimed at a given goal achievement or a given problem solution [14]. An algorithm should have the following qualities: simplicity and uniqueness; performance; divisibility into elementary steps. An algorithm is an object that visually shows the actions, and the order of their execution, necessary to achieve the final result for a user. Thus, taking into account the innovative activity of higher education institutions, the actual task is the creation of a decision-making algorithm, the use of which will complement and ensure the growth effect of supply chain management with higher education institution integration in the national innovation system.

The degree of declared issue elaboration. The works of such scientists as [1], [2], [3], [4], [5] and others are devoted to the issues of the national innovation system, its constituent elements, the principles of functioning, the functions being implemented, as well as to the experience of a balanced NIS development in economically developed countries. To a large extent, the researchers have been working on integration issues [9]

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of one of the most important elements of the national innovation system, namely higher education institutions (HEI). The issues of university science development, integration, as well as the problems that have developed in this area are considered in the studies by [17], [11], [12], [17], [16], [17] and other scientists. However, despite numerous studies of the theoretical and practical aspects of the national innovation system, and its element in the form of universities, science has not developed an approach to the decision-making algorithm to strengthen the integration of universities in NIS.

2. Methodology

The theoretical and methodological basis of the work refers to the developed forms of scientific and theoretical knowledge, namely, to scientific research and analysis of the theories and concepts being studied. In order to obtain scientific results, the article used the following set of methods: the method of analysis and synthesis is used to systematize supply chain management decisions. Plans and activities for the most similar characteristics, and to identify a certain sequence of actions with the order of their implementation inherent to the growth of integration level in the national innovation system. The method of graphical modeling was used to build an algorithm for decision making and visual steps of action modeling based on the studied data. The method of induction allowed us to pass from the individual, particular assertions to the generalizing conclusions of the study.

3. Study results

Higher educational institutions, as an integral element of NIS, have the properties and potential to provide a contribution to the scientific and innovative development of the state and to maintain an innovative economy [7]. However, universities constantly face a number of obstacles and problems requiring regulation, which negatively affects the level of their current integration in NIS. In this regard, it becomes urgent to have a clearly prescribed procedure ensuring the leveling of negative factors and the level of university integration increase. In the latter case, the implementation of a university integration process increase must necessarily be carried out by the supply chain management system corresponding to the relevant conditions of integration. The quality of the control system depends on many factors, among which the decision-making algorithm takes its place. Guided by these properties, the authors developed a decision-making algorithm to increase a university integration level in the national innovation system (Figure 1).

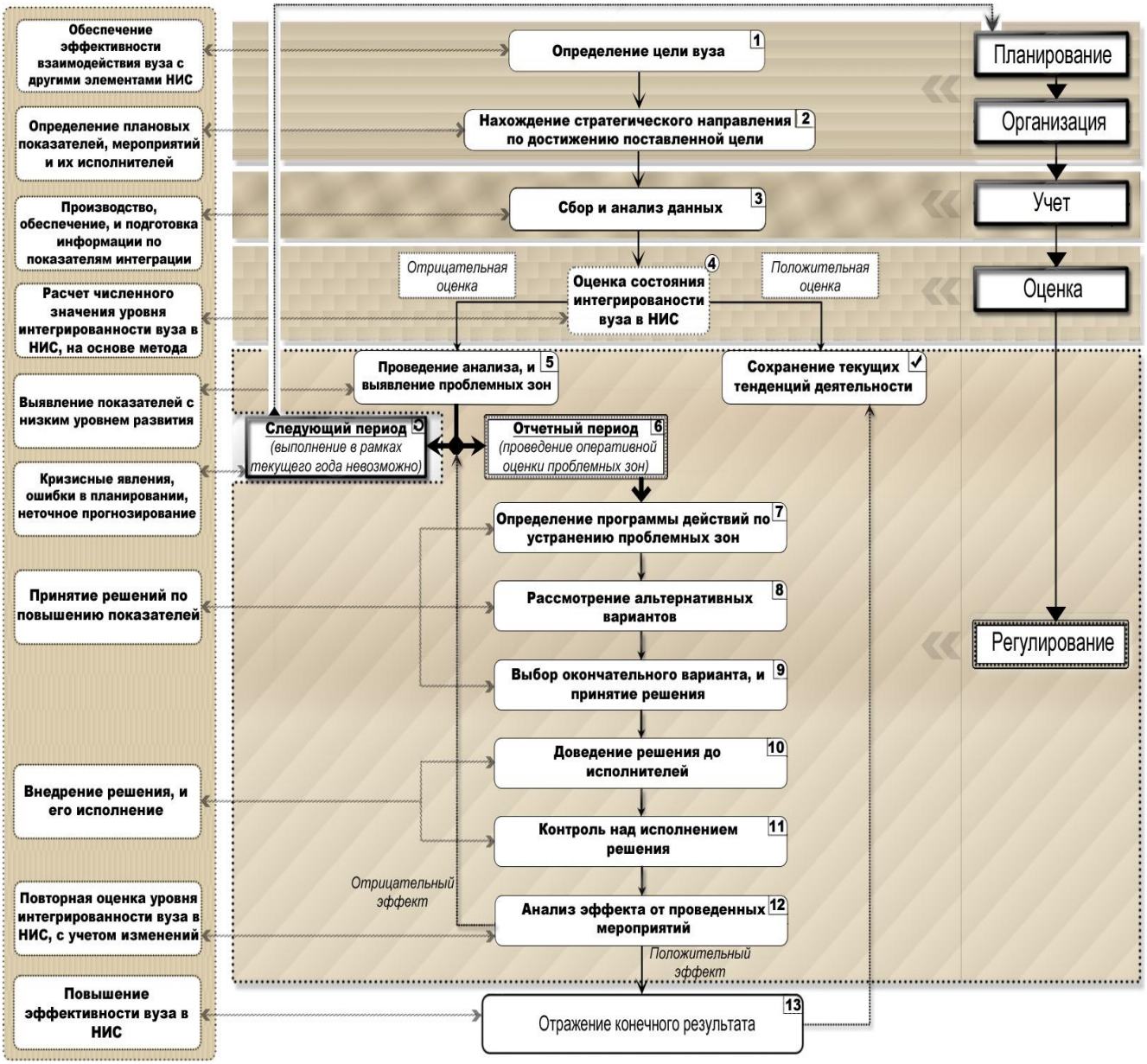

Figure 1 - Decision making algorithm to improve the level of university integration in the national innovation system

The main task of the decision-making algorithm is to maintain the supply chain management system through the implementation of consistently established steps, and the provision of a general goal implementation. So the distinctive feature of the proposed algorithm is the reflection of a specific set of steps and actions to improve the level of university integration in NIS. First and foremost, it is important to note that a full-fledged creation of an algorithm is impossible without the inclusion in the primary steps, the initial planning, organization and accounting functions that provide input to decision making. Thus, the developed algorithm contains thirteen steps, where the steps from the first to the second one reflect the planning and the organization functions in a narrow sense, and step three reflects the accounting function. Starting with step four, they begin the decision-making process on university integration level increase in NIS.

4. Discussion of results

Within the framework of the first step of the algorithm, the general goal of the university is determined, which is expressed in effectiveness provision concerning the interaction of a university with other elements of the NIS, then the second step is the formation of a strategic direction to achieve a goal through the definition of

planned indicators, activities and their implementers. Regarding the third step, the information on university integration indicators is collected and prepared. Evaluation and regulation are the final stages of a supply chain management system, ensuring the reflection of the final result. However, on the other hand, the achievement of the final result is not always possible. So the decision-making algorithm includes the ability to move from the current reporting period to the next one, which, if necessary, allows you to repeat the order of measures taken in the control system, starting with planning. The evaluation is the fourth step of the algorithm includes the calculation of the integration level indicator concerning a university under study in the NIS. After the assessment, a regulatory impact is activated, which contains a sequence of further steps to ensure that decisions are taken to increase the level of a university integration in the NIS. At the initial stage of regulation, step five of the algorithm is applied where the analysis is carried out based on the evaluation results, and the problem areas of the institution under study are identified. Regulation is possible with the transition to the next period, or within the reporting period. So, one of two possible options follows from the analysis results. In the first case, there is a step towards the next reporting period due to the impossibility of the current period regulation. In the second case, the transition to step 6 and the application of the regulatory impact in the current reporting period.

- Regulation is carried out in the next period. If, for a number of reasons, the regulation within the reporting period is impossible, there is an organic need for an established plan re-evaluation. The possible reasons that determine the absence of regulation performance possibility in the current period can be expressed in the form of external factors, crisis phenomena that have arisen after planning, in direct mistakes within a number of planned measures and indicators, the shortcomings in a team organization, incorrectly forecasting, etc. Thus, the result is the impossibility of the general goal implementation at least, which in its turn generates an acute need to organize the actions of a current situation elimination. In this case, according to the developed decision-making algorithm, the transition to the next period is carried out, with the return to the beginning of the supply chain management system, and the subsequent repetition of all activities according to the established functions, starting with the first step and planning. A new program of actions is determined, taking into account the need to rectify previously made errors and problems. A conclusion is made again about the possibility of the regulatory impact implementation in the reporting period on the basis of the analysis.

- Regulation is carried out in the reporting period. In this case, step six of the algorithm is applied, which in its turn becomes the beginning of a control action aimed at university integration level increase in NIS. The providence of current regulation allows you to adjust the outcome of the final result within the reporting year, and to reach better quality indicators. Regulation in this case is developed from a finite number of steps, starting from the seventh and ending by the twelfth step of the decision-making algorithm.

Let's consider each step of the current control, according to the established order. Step seven acts as a program of action determination to eliminate problem areas. Action programs are medium and short-term plans that are designed to fulfill a specific task. Thus, with the increase of the university integration level in the NIS, it is required to implement a number of special measures. To this end, the intermediate stages of each event should be identified, indicating the purpose, the nature and the content of each stage, then appoint a person responsible for their implementation, then identify the cash and resources, and finally specify the time frames for each stage, start and end date. The development of action programs is an additional process of the necessary and available means regulation, the desired conditions and time and material constraints [6]. In the framework of the study, the program of action is aimed at problem area elimination identified during the assessment of integration indicators. The straightening of the problem areas will ensure the growth of the university indicators, and hence the seven-fold increase of its integration level in the NIS. Depending on available resources, each institution decides on a set of activities included in the program activities independently. The next step in the decision-making algorithm is step eight, namely the consideration of alternative options. The program of action, developed in a specific situation and aimed at a specific problem solution, is more likely than other plans is subjected to unforeseen changes in the external environment. In order to overcome this shortcoming, it is necessary to draw up alternative options for actions and thereby prepare for various circumstances. In this regard, it becomes important, along with the main program of actions, to develop, as far as possible, spare program options, designed in the event if the assumptions and forecasts do not come true. Although the development of such alternatives is costly and rather difficult, an educational organization is able to regulate the established directions to achieve the goal only in this way quickly and effectively. Even when the situation does not correspond to any of the envisaged options for action, the preliminary consideration of alternatives

makes it possible to disclose possible changes and to anticipate the emergence of new environmental conditions [6]. After taking all the alternatives into account, step nine, the final choice selection, and the decision making takes place. At this stage, the final outcome is predicted for each possible action option, followed by the separation of less qualitative outcomes, and the identification of a single, most probable and effective option. A careful observation, based on the prediction of the results, makes it possible to choose from a number of options the one that proves to be the most suitable.

Since the chosen variant of actions determines the main trends of development, the next step of its implementation is the step ten of the algorithm, the bringing of decisions to performers. In order to implement an accepted decision, it is documented, with its subsequent transfer to the responsible persons. Each employee who participates in the process of a university integration level increase in the NIS should be informed about the tasks to be performed, as well as about the means required for this. Ensuring the implementation of a decision, a regulatory object should provide for the appropriate means and the forms of decision transfer to a team. For this purpose, direct exposure methods are advisable. They are aimed at resistance to innovation overcoming, at the change of attitudes and at participant interest increase in the process of a decision implementation, at the intensification of their activities and ultimately at the achievement of a general goal [13]. The methods of direct impact are called administrative methods. They are characterized by unilateral direct power influence of a supply chain management subject on the behavior of the managed ones. A subject of supply chain management makes a decision, the execution of which is mandatory. The failure to execute a decision implies negative consequences for an object [7], [20].

Administrative methods release specific forms of bringing the decision to the executors, which manifests itself in orders, decrees and instructions, in various regulations, instructions, standards and other service regulations that regulate the activities of subordinates and ensure their responsibility [18]. The next, eleventh step of the algorithm is the control over a decision execution. The authors believe that the control in the course of decision implementation concerning university integration level increase in NIS should be of a permanent nature. The process of control over the implementation of the decision covers the time from the implementation phase of the decision until its completion. The implementation of control activities is expressed in two key forms, namely the input and the output control [8], [19]. In the first case, the controlling effect at the entrance should ensure that all tasks resulting from planning are correctly distributed, and each of the employees involved clearly knows what he should do, what his responsibility is for the violations. Control should not inspire fear, and therefore the purpose of control will be not prohibition or threats, but the maintenance of an optimal regime in the work of subordinates. In the second case, the controlling effect on the output is based on the need to track the results of production tasks, their current analysis and subsequent adjustments. The output control is designed to perform the functions of monitoring and current process regulation. The specificity of the output control is that a judgment is made about the work at all stages, based on the activity results [15]. The next, the twelfth step is the analysis of the effect from taken measures. In practice, the efficiency from the performed activities is most often determined analytically or expertly, by the comparison of many elements, where the degree of a goal achievement is always the main one. So the efficiency from the spent activities can be defined as the degree of an actual result correspondence with the planned one [13].

The re-evaluation of university integration level in the NIS occupies its place. Namely, a new, actual result of the evaluation takes place, the correlation of which with the planned result, will ensure the reflection of the effect from the conducted activities fully. Based on the results of the analysis, a conclusion is drawn about the effect of the measures taken. Thus, a decision is made about a negative or a positive quality of the result. If the obtained result from carried out activities is negative, namely, there are discrepancies in the part of the previously planned result, then, according to the decision-making algorithm, a transition to step 5 takes place, the analysis and the identification of problem areas occurs. The transition to the initial stage of regulation is provided, with the subsequent repetition of the whole cycle of measures. If the obtained result from carried out activities is a positive one, the supply chain management system shows effectiveness at all its stages, and the decision-making algorithm is effective, then the general goal can be considered as achieved. The transition to the last thirteenth step of the algorithm and the reflection of the final result takes place. In this case, the final result is reflected in the form of university performance increase, the development of its scientific and innovation environment, the growth of integration level in NIS, which in its turn ensures the achievement of the general goal of university efficiency increase in the national innovation system.

5. Summary

Thus, taking into account the developed decision-making algorithm for a university integration level increase in the national innovation system, we believe that the application of these provisions is able to improve the level of studied university integration in the NIS qualitatively, and therefore to ensure the growth of its performance indicators. Besides, the growth of university performance indicators and the increase of its integration in the NIS directly increase its contribution to the development of the national economy, and other priority areas of the state. The principle which determines the university interest in the integration level increase in NIS is the growth of performance indicators and the development of a scientific and an innovative component. On the other hand, the development of its elements for the national innovation system is a qualitative process that ensures the well-being of economic and social spheres of the state life. In other words, any system tends to improve, regardless of the conditions and the forms of existence. Thus, the development of such an element of the national innovation system as higher education institutions, symmetrically satisfies two directions at the same time, namely, the increase of higher education institution importance, their improvement, the strengthening of influence in priority scientific and innovation directions of the state, as well as a direct development of the national innovation system through their integration level increase in NIS. In this regard, the algorithm proposed by the authors fully meets the above-mentioned conditions. The functioning of a highly integrated university will have a first-class nature that will have a qualitative impact on NIS elements. In its turn, a large-scale manifestation of such practice will have a direct impact both on the growth of the national economy and on the strengthening of a balanced NIS.

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