Subject features of engineering activities of the supporting university

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Abstract. The subject of the research is a subject basis of the inter-branch and interdisciplinary integration of modern scientific and technological processes in the “supporting university - industry” system. Subject features of engineering were described using the methodology of the post-industrial society and post-non-classical stage of scientific development. Analysis of materials allowed for the conclusion that it is necessary to consider engineering at the theoretical (in developed form - at the epistemological) level rather than using its empirical and information models. The complex interaction of disciplinary, general scientific and socio-ideological components in the relationship between the university and its interdisciplinary environment belongs to one of the most important features of the subject basis of engineering in the supporting university.

1. Introduction

Modern science and its disciplines and technological applications search for integrative ways of development. The creation of a supporting university is a beginning of new changes in the integration research and educational space. The research topics include interaction of various classical branches of knowledge and complex inter-sectoral technological processes permeated with information and infrastructure problems of the region.

The research subject is a subject basis of joint innovation activities of the supporting university and developing regional industries. The subject activity in the system of engineering education, regional industry and collective researches will become a key factor in the understanding of interdisciplinary and intersectoral events in the region involving supporting universities. These events are due to profound changes in modern science and technology manifested in changing forms of collective work of scientists, interdisciplinary connections, ways of interaction of universities with society, government and entrepreneurship. The entire range of cognitive and social parameters of the subject of engineering and technological activities changed. Informatization and computerization, application of artificial intelligence and automated programs for managing the life of regions have a special influence on the content of engineering.

2. Problem Statement

The subject activity in the system of engineering education, regional industry and collective researches will become a key factor in the understanding of interdisciplinary and intersectoral events in the region
involving supporting universities. Under deep transformations of modern science, technology, interdisciplinary connections, ways of interaction of the university with society and government, the study of engineering in the the supporting university is crucial.

The purpose of the research is to reveal subject features of engineering in the process of interaction of educational technologies of the supporting university and the industrial development of the region. Understanding the scientific and educational features of the supporting university which is a coordinating element in relation to innovative events in the region, is a necessary task for the development of engineering education.

3. Research Methods
The research methodology is based on the theory of the post-non-classical stage of development of science and post-industrial society. Interdisciplinary, systemic, and structural-functional approaches were used to reveal the nature of the analyzed phenomena. This research methodology has been chosen in accordance with one of the priority areas: the dominance of inter-sectoral and interdisciplinary integration in the development of scientific, scientific and technological knowledge.

To solve the research tasks, it is necessary to identify fundamental changes in the interaction of scientific knowledge and information. These changes will positively affect the innovative state of social practices. The methodological criterion for obtaining these results is the statement that scientific knowledge is a basis for the production and consumption of technological information.

4. Results and discussion
In our previous works [1], we have already paid attention to social and cognitive components of educational technologies in the supporting university. It has been emphasized that the analysis of these components makes it possible to overcome conceptual and temporal gaps between scientists, scientists and engineers, entrepreneurs, industry experts and authorities. Elimination of time gaps between scientists and engineers is easier to understand in the aspect of historical stages of science development. It is the transition of scientific knowledge from its classical and non-classical stages of development (which was inherent in the science of the 20th century) to the stage of "post-non-classical" (modern) development.

At the previous stage of development of science and technology, when comparing the concepts of engineering and scientific and technical knowledge, mostly unambiguous (simplified) meanings prevailed. Scientists and philosophers studied the content of scientific and technical competencies and the existing scientific and technical knowledge base. The personal (subject) model of an engineer as a unity of scientific and technical knowledge served as a starting concept for revealing the nature of engineering. The scientific nature of technical knowledge was considered as interaction of two components. The first one includes fundamental sections of natural science which have their own specifics and gnoseological characteristics. They are subject to logic, the laws governing the development of abstract mathematical knowledge and experimental data processing in fundamental research. The second component of scientific knowledge is linked with the design and engineering activities. The epistemological and methodological characteristics of this component are different from those of natural sciences. It was expedient to associate the natural scientific specificity of technical knowledge with the concept "technical science", and the scientific specificity of technical knowledge with the concept "engineering science." Of course, these conceptual considerations are still relevant. At the stage of the post-non-classical development of science, the number of characteristics affecting objectivity of ideas about the model of engineering has changed. A software component was added. At the same time, the volume of interdisciplinary and interdisciplinarian research which complemented complex software engineering knowledge increased. All this required fundamental changes in views on the phenomenon of engineering, its interpretation on the theoretical basis. The concept ‘engineering’ was actualized.

The study of various aspects of the newest element in the system of Russian higher education (the supporting university) requires effective methodological principles. One of them is the determining role
of scientific knowledge in the creation and application of information. This principle can be applied to scientific and technological information flows, information development of social practices, and theoretical analysis of mechanisms of program management. A number of foreign publications emphasize the priority attitude of students to conceptual and theoretical solutions (instead of simple informational and empirical approaches) in the process of creative mastering of disciplinary knowledge. For example, [2] presents solutions for open problems in the chemical-reactive engineering using an instructor from a virtual laboratory. The study was conducted by a teacher as an educational experiment in teaching the technique of chemical reactions. The students developed recommendations on how and under what conditions they would implement their solution. The results of this examination were effective for determining the ability of students to solve thematic problems. Students explained their understanding of the problem either analytically, through the use of conceptual approaches, or based on their empirical skills. For the teacher, this method provided an opportunity to differentiate groups of students according to their theoretical abilities to carry out information engineering activities.

Projecting the principle on the research area, we can confirm our conclusion. It involves the need to reach the theoretical level of engineering analysis, i.e. to move from empirical software-information models of engineering activities to theoretical (epistemological) ideas.

The similar interpretation ca be found in [3]. It addresses the problem of unstable demand and supply of innovative knowledge and innovative talents. The article says that through research, one can understand mechanisms and logical links of innovation activities of the university and industry. This activity is implemented through the knowledge chain and knowledge management scheme as results of joint university innovations, regional industry and research. Scientists have developed a "reengineering model" of management concepts, organizational structure and joint innovations in the form of optimal information technologies. The article [4] is devoted to self-organizing systems of smart cities (a case study of intelligent transport systems in China). Smart cities are actively developing around the world, especially in China. However, there is no unified interpretation of the smart city system. This negatively affects their assessment and the quality of planning. In this regard, it was proposed to explore the most reliable aspects of the city at the previous stage of its existence. And then information improvement measures for the overall integrated self-organization system should be developed. These three dimensions (self-organization, information and communication technologies and development mechanisms) are combined into an intellectual urban assessment system.

Thus, the priority of the theoretical level of analysis of the software-information model of engineering is a stable feature of the subject basis of engineering in the supporting university.

Regarding general scientific ideas about the subject basis of the joint innovation development of engineering universities and industries, foreign publications often contain sociocultural and political comments. In [5], a group of scientists from South Korean science and technology universities investigated internationalization of higher education. The results showed that supporting internationalization of higher education, participants in the research experiment perceived the lack of choice when selecting the language humanities disciplines as a serious problem. The local language was perceived as preferable when mastering and applying humanities and social social sciences.

Some scientists [6] explain behavioral preferences of participants in social commerce not only by their desire for utilitarian and economic properties of products. Scientists believe that consumers of market products can master social commerce to achieve social values. A survey of university students reveals that the desire for socialization, rather than utility was a driving force. The results of this study characterize social commerce as a means of achieving social values in the form of an increase in social capital and social activity. This direction of the market trade fits into subject characteristics of university innovative activities. The need for social values in the form of increased social capital and social activity is one more feature of social engineering typical of the supporting university.

It is easy to see that many statements of scientists about cognitive and social organizational principles of the development of universities are similar to the concept of sustainable development. For example, in many Russian universities with an information technology profile, much attention is paid to research on software systems based on the principles of stability (noise immunity). The search for a correlation
between the corporate culture of social sustainability (factors of corporate values, successful practices) and the financial success of the university or company is of interest [7].

In foreign publications, the problem of sustainable development is solved from the standpoint of interdisciplinary processes. In [8], scientists study sustainable development mechanisms that influence institutions, policies and practices, improve social and environmental conditions of the region. Within this interdisciplinary trend, research approaches established within isolated, reductionist, disciplinary sciences lose their significance. Approaches that unite different disciplines and attract a wider range of transdisciplinary participants as a way to increase the sustainability and effectiveness of research are used. Various aspects of an interdisciplinary research approach are used for solving the problem of the sustainable development of innovation processes [9-12].

5. Conclusion

The following conclusions can be drawn.

1. In preparing high-tech specialists, features of engineering include direct relationship of the university with the research of the latest program management mechanisms.

2. The priority of the theoretical level of analysis of software-information models of engineering instead of empirical approaches. The subject-research model of engineering includes sociological and epistemological characteristics. Complex interaction of disciplinary, general scientific and socio-ideological components in the relationship between the university and its interdisciplinary environment is required.

Thus, the term "engineering" supplemented by the content of these findings fits into analytical procedures for revealing the nature of modern engineering activities carried out the supporting university.

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