

Implementation of the “Frugal Innovation” Concept in Training of Masters in Innovations

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Abstract— The article presents the main competencies formed during the study within the frames of the master's program in the field of "Innovations" in the conditions of the "Frugal Innovations" concept. Smart cost technologies are integrated into the disciplines of the master's program for trends in breakthrough growth strategies, in order to active iterative interaction, the wise use of production capacities and resources, to improve the development of environmentally friendly and resource-saving solutions, and to implement the cultivation of a cycle economy. The article lists the acquired competencies and annotations of disciplines on the trends of “frugal Innovations”

Key words— *frugal innovations; cyber physical system; digital transformations; commercialization of innovation results*

I. INTRODUCTION

The dynamics of terms in the field of innovation are rapid. Until recently, the classification field of innovations contained 3-4 gradations: process, marketing, product, organizational. Now this classification field has at least 10 grades, including revolutionary innovations, pseudo-innovations, breakthrough innovations, technological innovations, improving innovations, open innovations, etc. Another gradation appeared – “frugal Innovation”. This innovation is associated with the usage of “smart costs” technologies simultaneously for all enterprise resources – financial, industrial, material, human, informational, etc. Frugal innovations are introduced both in a high-tech enterprise and in entrepreneurship. Frugal Manufacturing is no longer enough. It requires process management of the “factory of processes” based on the technologies of “Frugal Production”.

II. TRAINING IN THE FIELD OF TECHNOLOGICAL INNOVATIONS MANAGEMENT

Master programs in the direction "Innovation" in most cases are devoted to the study of current trends in technologies of business systems management. For example, the master's program in Innovation in St. Petersburg State Technical University of Peter the Great is being developed for masters of the Higher School of Cyber physical Systems and is called “Application of CALS-technologies in the management of innovations”, the master's programs in St. Petersburg State University-ITMO in the field of “Innovation” are devoted to the introduction of innovative technologies in marketing, innovative entrepreneurship, scientific communications, art and science, transport etc. The master's program in the direction "Innovation" is called

"Management of Technological Innovation" and is dedicated to providing a multi-stage training system in the field of creating new products and managing innovative processes for high-tech industries. A high-tech knowledge-based enterprise is seen as a digital enterprise. The digital enterprise uses new digital information cognitive technologies at all levels of management to increase the efficiency of its activities. A digital enterprise is seen as a complex dynamic system, a cyberphysical system [1, 2, 3].

In the processes of digital transformations of high-tech industries, technological innovations occupy a special place, since this type of innovation is associated with the development of new or improved technological processes. Due to the fact that the necessary and sufficient stage of digitalization at the initial stage is the informatization of the management processes of all enterprise resources at the same time the special role of technological innovations in the digitalization process occurs. Thus, the technology of transformation of measuring information about the cyber physical system – its technical and socio-economic subsystems – is initially changing.

The idea of the program is to prepare graduates for professional design and scientific activities in the field of development, implementation and maintenance of innovative projects for high-tech science-intensive enterprises in the context of digital transformations.

The relevance of the program consists in the training of specialists in the field of innovative design and technological entrepreneurship, as well as in creation of a personnel training system with engineering and managerial education on the orders of industrial enterprises, scientific and educational organizations and public administration institutions.

The readiness of graduates for the technological innovations life cycle project management will ensure the continuous management of innovation and the direct participation of graduates in the creation and promotion of high technology products in the context of technological modernization.

Students study modern and promising methods for managing innovative projects, methods and models for assessing the readiness, maturity of information and communication infrastructures of high-tech enterprises for digital transformations, technology for organizing start-ups in the context of open innovation, technology transfer technology and commercializing the results of innovative activities. A study of the technologies

of "Frugal Production", "Process Factory" is being implemented.

Students are getting knowledge in the field of choosing the necessary composition of the digital enterprises infrastructure, business systems, ecosystems, corporate information system architectures, digital communication technologies, Internet of things, multi-agent systems management technologies, enterprise resource engineering and reengineering technologies, business analytics technologies, and methods examination of innovative projects, methods of conducting a technological audit.

The methods and models for assessing the competitiveness of innovative products, methods for calculating the cost and formation of the product market price, methods for assessing the expected profitability of new products are studied as masters' instruments for setting and managing the commercialization of the innovative activities results in the context of "frugle innovation" taking into account organizational and commercial risks, methods of financial and economic modeling of business processes [4, 5].

The department implements a research project "Research and analysis of cognitive technologies for assessing the innovative complexity of a digital enterprise."

Graduates of the program successfully work in the field of project management, development and implementation of IT services, corporate information systems, in IT consulting, digitalization of technological processes, optimization of business processes, business planning, production planning at the following enterprises: LLC Regul +, PJSC Signal, Committee for Energy and Engineering of the Government of St. Petersburg, St. Petersburg State Unitary Enterprise "St. Petersburg Analytical Center", PJSC "Techpribor", OJSC RNII " Electronstandart, Elektropult OJSC, Avangard OJSC, Almaz LLC, Techsnab LLC, RESTEC EXHIBITION ASSOCIATION, GAZPROM PJSC, MMS RADAR LLC, as well as for small and medium enterprises with the introduction of innovative technologies.

III. THE MAIN FEATHURES OF IMPLEMENTING THE CONCEPT OF "FRUGAL INNOVATIONS" IN THE MASTER DISSERTATION

To illustrate the features of introducing the concept of "Frugal Innovation" in the Master's program "Management of Technological Innovations", we will present the competencies formed as a result and focus on competencies that contain knowledge, skills related to the "Frugal Innovation" concept. It is planned to attract undergraduates for studying the following topics:

1. Development of information and communication infrastructures of innovative entrepreneurship in various areas of business
2. Development of the domain-specific IP life cycle innovative projects
3. Examination of innovative projects
4. Methods and models for assessing the economic efficiency of innovative projects

5. Information systems and technologies for automation of innovation management of a high-tech enterprise
6. Formation of a high-tech enterprise development strategy
7. Risk assessment of scientific and technical products in the commercialization of research results
8. Managing technological innovation in service-oriented IP
9. Innovative entrepreneurship in the field of electronic business
10. Process management of cyber physical systems based on the technologies of the Internet of things, Internet of people, Internet services for a digital enterprise.

The final qualification work (dissertation) of undergraduates in the Innovation area should be a finished research work devoted to the problems of improving the mechanisms for creating, promoting, introducing and using innovative products, technologies and services in various fields of human activity. The work should contain an analysis of the problems of implementing business processes in the selected subject area, an assessment of possible solutions to them using the results of innovation, an analysis of the methods and tools used in choosing options for solving problems. The subject of research can be: the effectiveness of the implementation of innovative solutions in various, including new (non-traditional) areas of activity; assessment of the competitiveness of innovative products and services in relevant markets; profitability assessment for the developer of the costs of creating, manufacturing and launching new products on the market; selection of appropriate ways to implement innovations within the framework of the concept of "lean innovation", etc. An important emphasis should be on the consideration of economic, market aspects of innovation.

IV. THE MAIN TRENDS OF USING THE CONCEPT OF "FRUGAL INNOVATIONSES" IN THE EDUCATIONAL PROGRAM OF THE WESTERN UNIVERSITIES

Traditional innovation processes are characterized by high cost and are focused on the consumer segment, characterized by a high level of income. Products and services that are the result of these innovation processes rarely meet the needs of low-income customers, especially in B2B and B2C markets of developing countries around the world. Using the concept of "Frugal Innovation" will create and develop new markets for innovative products, which will lead to an increase of the population living standards and the socio-economic development of developing countries and, in particular, the Russian Federation.

The concept of "frugal innovation" has gained immense popularity in the countries of Western Europe and the USA in the last few years. Thus, in 2018, a joint educational program was opened by the Engineering School of the University of Santa Clara (USA) and the Department of Science and Technology Management of the Hamburg University of Technology (Germany), offering the study of disciplines in the following areas: determining customer needs based on project approaches, generation and testing of concepts, architecture of innova-

tive products and product planning for “frugal innovations”, motivational, strategic, and organizational aspects of “frugal innovations.” In addition, the Center for Lean Innovations was established on the basis of this master's program, carrying out research and implementation activities "Frugal Innovation through the provision of consulting services to enterprises in the high-tech sector of the economy. The Leiden University of Technology and the Rotterdam University of Technology in September 2018 opened an educational The Lean Innovation program for sustainable global development, including theoretically oriented courses that explore the basic concepts of Frugal Innovation, methods for promoting innovative and inclusive technologies adapted to local conditions, and internships in developing countries (Uganda, India or South Africa). During the internship, students develop solutions related to Frugal Innovation. The program is aimed at students with any basic education, interested in working in an interdisciplinary environment. It is emphasized that the program is especially useful for students with a technical education, since it allows to acquire skills in the field of ensuring the applicability of technology in real-world conditions, taking into account political, economic and social factors.

The introduction of the “Frugal innovation” concept in the educational program allows not only to provide students with training in accordance with international trends, but also to train personnel for high-tech industries, taking into account the requirements of innovative product markets of developing countries.

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