Peculiarities in Shaping Staff Professional Skills in Fishery Industry
("Production Machines and Facilities" Education Program)

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In leading countries, fishery industry is characterized by high scientific and innovation potential, which makes it one of the leaders at international consumer market. The Russian fishery industry is significantly lagging behind not only other countries in terms of hydrobionts’ processing technology, but also Russian pharmaceutical companies and biotech firms.

One of the reasons why Russian fishery industry is lagging behind is low professional level of engineering staff involved in this production. To remedy the situation, it is required to revise engineering training transferring it from qualification-oriented approach to competence-based one, with a graduate acquiring not only professional competences but also skills in innovative ventures.

Having high scientific and innovative potential, food industry takes a leading position in the countries with developed market economies [2]. The scale and pace of its development is defined not by the commitment of certain economic sectors to structural changes and investments, but by market conditions and, primarily, rate of consumption demand change.

Today, food industry is naturally combined with biotechnological, microbiological, chemical and other branches of industry as it actively uses such products as food additives, flavoring, structure-forming agent, packing, and other ingredients used in food technology [10]. The food industry involves a great number of various machines and equipment to maintain complex technological processes of transferring raw material into semi-products and end products. While being processed, raw materials undergo physical, physico-chemical, microbiological, biochemical, structural, and composition changes. This requires professional staff to have integrated knowledge in characteristic features of the above-mentioned processes since such kind of knowledge is the fundamentals of food technology [2, 8].

The present state of food-processing industry of the Russian Federation (RF) can be characterized as a crisis as the export of raw materials and import of end products have been priorities of the country over the past 10 years [7]. Actually, this has contributed to the lagging behind of Russian food-processing industry and degradation of engineering staff professionalism of the corresponding companies. At the same time, it is a well-known fact that it is engineering development that defines innovation progress of any country.

To bridge a gap, the RF Innovative Development Strategy up to 2020 has been developed to reinforce the position of Russia at the markets of high-tech and intellectual products by increasing the share of high-tech sector in GDP from 10.9 up to 17-20%, while innovation-driven companies account for more than a half of the domestic hydrobiont market. In recent years certain progress has been made in fish production and it is currently on an equal footing with other agricultural and food industries. Precisely, the growing rate of fish production volume is 7.5%, while the share of domestic seafood products at the consumer market increased by 4.6%. The increase in production volume of certain types of fish products is also a good sign [3]. At the turn of the century, there was a dramatic breakthrough in technological infrastructure of a number of fish-processing plants due to implementing innovative and cost-effective production machines and facilities. The technological infrastructure of these enterprises was expanded by a wide range of up-to-date machines and equipment which are involved in complex technological processes, i.e. multi-stage processing of raw materials and semi-products.

This leads to significant enhancement of traditional technological processes and implementation of new hydrobionts processing technologies. Based on the level of technological advancement, these enterprises are competing with leading foreign companies or even surpassing them in certain production aspects.

However, it should be stated that the competitiveness of domestic fish-processing industry is still rather low, which is resulted from weak investment activity, insufficient level of technological advancement significantly lags behind not only the world’s leading hydrobiont processing companies, but also domestic high-tech industries, such as biotechnology and pharmaceuticals.

Most engineering solutions are proposed with no regards to machinery specifications, analysis of technological system potential under certain operation conditions and in relation to processed raw materials and other processes, medium characteristics, which, in its turn, constitutes a serious challenge for domestic engineering workforce [2].
Precisely, it is a well-known fact that:  
- production engineers do not know about the advances in the machinery being used, effective modes of equipment application, and physical bases of the processes;  
- machine operators have no enough knowledge in chemical, microbiological, fermentative, and other aspects of the discussed production;  
- production staff do not demonstrate deep and systematic knowledge of production processes, and, sometimes, they have no relevant education.  
Such deficiencies in staff education impede complex understanding of the production product's physico-chemical parameters and organoleptic properties. Even if the employees have enough experience in the relevant industry, nevertheless, they are not able to solve the problems independently and carry out complicated operating processes, as they have no managerial skills and competences in economics. This fact usually leads to technical mistakes and ineffective marketing strategy.

To provide a way out of this vicious cycle, the enterprises need to build a team which would be made of engineers, production engineers, and marketing managers. It is such a team that could effectively address the tasks related to product design, production, and sales. It is worth noting that it is not only essential to design original food product, but also to preserve its specific properties for a long time.

As a result, graduates have fewer opportunities to find a job in accordance with their education, and, thus, they have to work in other economic sectors [9]. The lack of high prestige for engineering professions and extremely low pay rates have accustomed to pessimistic view of modern youth values — engineering professions, research work in Research and Development Institutes are no more attractive for modern school-leavers.

Thus, it can be stated that the level of modern engineers’ knowledge constitutes a danger to the competitiveness and impede technical development of the country at present. Therefore, it is required to reform national engineering education systems. Under current conditions, higher education system should always be flexible towards social transformations and to changing social expectations, and gradually evolving. “Bachelors and Masters of Engineering”. It is obvious that the past engineering educational system is no longer effective, since the market is searching for engineers-innovators and high-tech inventors. The holders of a master’s degree are only those who are able to meet these requirements as their professional activity is basically aimed at scientific, technological, economic, and social progress of the community, as well as characteristic features of science-driven industries themselves [6].

In order to provide a part of elite professional training is which it is intended for 15-20% of bachelor’s degree holders. As the Bachelor-Master education system is not uniform, the content of master’s education programs is determined by the university itself in accordance with the scientific interests of the leading faculty members (professors). It is explained by the fact that master’s training is primarily based on the research conducted by faculty members, as well as required facilities of graduating departments.

To address the issue, it is required to transform engineering training from “qualification” to “competence” one, since the competence-based approach is the only way to ensure high quality of education. The main goal is development of key competences that graduates should attain in order to solve their professional tasks. First of all, a graduate must be capable of working with information, i.e. to know algorithms, data searching and processing techniques. To acquire these competences, a wide range of software products should be applied within engineering training programs. The knowledge of software products might be an extra bonus for a future employer. When it is impossible to apply a traditional approach to problem solving, an engineer should be able to suggest nontrivial solution, i.e. creativity — the second key competence for a graduate to acquire. Finally, an engineer should possess relevant social and personal qualities that are required to work effectively in a team framework including the ability to lead a team, especially in a highly ambiguous, uncertain and unpredictable environment, and assume the responsibility for the entire team and project implementation [9].

However, to introduce a competence-based approach into engineering education, it is essential to address a number of challenges, such as development of the relevant evaluation criteria and knowledge assessment methods, unwillingness of the faculty members to revise education methods, poor understanding of the two-tiered engineering education system [8].

Lack of faculties at universities is another problem that merits closer consideration. The high quality of engineering education is primarily dependent on the availability of up-to-date lab facilities and equipment which are an obligatory part of practice-oriented training. Within the practice-oriented approach, students have opportunities to engage in a variety of relevant practice-related experiences. In this regard, the university should become a center of region’s innovation system incorporating various innovative research and training departments which would allow university to integrate education and training in order to find the solutions for a number of regional social and economic problems. The university education system will guarantee continuing professional development of all faculty members including the possibility to work with up-to-date facilities and equipment. Engineering training must be provided with due regard to technological advances and relevant professional training. To acquire these competences, a wide range of software products should be applied within engineering training programs. The knowledge of software products might be an extra bonus for a future employer. When it is impossible to apply a traditional approach to problem solving, an engineer should be able to suggest nontrivial solution, i.e. creativity — the second key competence for a graduate to acquire. Finally, an engineer should possess relevant social and personal qualities that are required to work effectively in a team framework including the ability to lead a team, especially in a highly ambiguous, uncertain and unpredictable environment, and assume the responsibility for the entire team and project implementation [9].

It is a well-known fact that the universities, which are under commission of the Federal Fishery Agency, train the engineers for fish-processing industry programs “Production of Machines and Facilities” (specialization “Machines and apparatus of food...
In recent years, low-technology industries have been developed in the “fishery” regions of Russia [3]. In addition, modern production conditions, especially within medium and small-sized business, place increasingly high demands on the quality of engineering education. Therefore, it can be stated that today the graduates who possess relevant professional skills are of significant value. It means that universities should train not an “abstract” engineer, but an engineer of the next generation, an engineer who will suit to a definite industry, for example, refrigerating engineering capable of operating industrial cooling and refrigerating equipment.

In this respect, according to the Federal Fishery Agency task, Far Eastern State Technical Fisheries University has developed a bachelor’s/master’s degree program “Production Facilities and Technologies of Fish-Processing Industries” in order to train engineers for hydrobionts processing [5]. The program was developed by the leading faculty members of Far Eastern State Technical Fisheries University, particularly the faculty of Production Machines and Facilities Department, Professor of Moscow State University of Food Production, V.A. Grokhovskiy; head of Food Production Technology department, DSc in Technical Sciences, Professor, Murmansk State Technical University; V.N. Erlikhman, dean of Mechanics and Technology Faculty, DSc in Technical Sciences, Professor of Food and Refrigerating Machinery Department, Kaliningrad State Technical University. Thus, it can be stated that the leading faculty members of the most well-known fishery universities of the country have been involved in the education program development.

In accordance with the developed program learning outcomes, a graduate should demonstrate the skills necessary for research, design, production, energy-efficient and environmental friendly activities. The focus of graduates’ professional interests is on professional engineering, i.e. the combination of engineering science and engineering management [2]. The essence of the process engineering correlates with the change of physical phenomena of energy and mass transfer, chemical, biotechnical, and microbiological transformations, as well as fundamentals of heat-and-mass transfer, physical chemistry, and mechanics. The integrated knowledge in the peculiarities of these processes is the basis for effective professional activity within the fish-processing industry.

The process engineering is aimed at the modernization of fish-processing industry development demonstrate continuous innovation and technological effect achievement. Therefore, the focus of the developed education program was made on shaping students’ competence in using interdisciplinary knowledge of international experience and practice. Moreover, the issues related to effective production process and system complexity, therefore, the content of education program reflects the basic international trends in development of hydrobiont processing industries.

In this respect, the program was developed in accordance with the modern requirements towards fish-processing industry management, quality management, and technological infrastructure. On the other hand, the learning outcomes is the ability to make a wide range of decisions. Since the rate of fish-processing industry development is directly dependent on the technological process improvement, quality enhancement of end products, and technological effect achievement. Interdisciplinary experience and knowledge in relation to technological and managerial tasks allow engineers to reveal the limitations of the production systems, eliminate the disadvantages of production process and go ahead towards the promotion of high-tech products, which, in turn, will contribute to enterprise competitiveness.

Therefore, it can be stated that today the leading faculty members of the most well-known fishery universities of the country have been involved in the education program development. The program “Production Facilities and Technologies of Fish-Processing Industries” must be able to modernize the technological infrastructure in enterprises and organizations, as well as to ensure complex use of raw material, high quality of end products, enterprise cost efficiency and environmental safety.

In conclusion, it should be noted that it is due to scientific innovations the fish-processing industry can function effectively within a highly competitive environment. In that connection, there must be a clear understanding that there is no alternative science for Russian Federation. In recent years, low quality of domestic products and economic conditions in processing industries have been resulted from the limited use of international experience and practice. Global trends in processing industry development demonstrate continuous increase in the level of technological process and system complexity, therefore, research and teaching technical sciences, producers, as well as scientists and engineers, must be involved in solving the issues related to effective production process, product design and manufacture with due regard to environmental safety. Thus, the content of education program reflects the basic international trends in development of hydrobiont processing industries.

In addition, the program was developed in accordance with the modern requirements towards fish-processing industry management, quality management, and technological infrastructure. Once the learning outcomes is the ability to make a wide range of decisions. Since the rate of fish-processing industry development is directly dependent on the technological process improvement, quality enhancement of end products, and technological effect achievement. Interdisciplinary experience and knowledge in relation to technological and managerial tasks allow engineers to reveal the limitations of the production systems, eliminate the disadvantages of production process and go ahead towards the promotion of high-tech products, which, in turn, will contribute to enterprise competitiveness. It is obvious that modern engineering education must cover major disciplines of the fish-processing companies in order to ensure the utilization of raw material, high quality of end products, enterprise cost efficiency and environmental safety.

Being adapted to the current realities, the program is offered by all the universities which are under commission of the Federal Fishery Agency. In conclusion, it should be noted that it is due to scientific innovations the fish-processing industry can function effectively within a highly competitive environment. In that connection, there must be a clear understanding that there is no alternative science for Russian Federation. In recent years, low quality of domestic products and economic conditions in processing industries have been resulted from the limited use of international experience and practice. Global trends in processing industry development demonstrate continuous increase in the level of technological process and system complexity, therefore, research and teaching technical sciences, producers, as well as scientists and engineers, must be involved in solving the issues related to effective production process, product design and manufacture with due regard to environmental safety. Thus, the content of education program reflects the basic international trends in development of hydrobiont processing industries.

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On the Key Problem of Engineering Education in Machine-Tool Industry

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The article considers the necessity and opportunity to develop a system mechanism model as an academic process reorganization basis for engineer training in the machine-tool industry.

Key words: mechanism, function, structure, subject of apprenticeship research.

During many years of education reforms experts in philosophy, psychology, pedagogy, information did great amount of work on principle issue of educational methods and techniques in our country including – engineer professional training. However, broad debates on the issues of engineering education virtually leave open the questions of its professional content. It is impossible to educate a specialist outside the limits of professional expertise and this or that subject area in the engineering industry. Besides, content and arrangement of teaching material, intensity and quality of academic process, as well as anticipating character of an engineer training should be defined. In the condition of modern cognitive technique application the basis for educational framework is the modern knowledge system in the industry.

In the content of engineering knowledge of any sphere one can distinguish two main constituents: an engineering facility of the object. The accepted mechanism, function, structure, subject of apprenticeship research.

Theoretical bases of courses were taught to develop abstract thinking of students. The theoretical researches of scientific schools were particular illustrative.


The stage of original model development and knowledge in some engineering spheres accumulated today can be divided into sufficient time period. During the harmonious process of engineering education development its achievements can be applied (under the condition of feedback) to correct continuously the initial concepts. In real engineering knowledge development processes there is no such correction. Obsolescence of basic assumptions on the object, their inconsistency with potential modern cognitive and information techniques is typical, to some extent, for all industry branches depending on their age. Machine-tool industry is one of the oldest engineering branches, hence, it is particularly illustrative.

In Russia key assumptions about machines and mechanisms have developed on their disciplinary base by the end of the 19th century. At the initial stage such fundamental disciplines of professional education as following were chosen: "Descriptive Geometry and Graphics", "Theoretical Mechanics", "Material Resistance", "Theory of Mechanisms and Machines" "Machine Parts", "Material Science" and others. At the initial stage of engineering education development theory issues were of particular importance. The theoretical bases of courses were taught to develop abstract thinking of future specialists. During the further development, engineering knowledge itself was improved and new disciplines appeared. For example, "Limits and Fits" is a discipline dealing with issues of part size precision, as well as disciplines associated...