PROBLEMS AND MECHANISMS OF DEVELOPMENT OF THE MODEL OF ACADEMIC PERSONNEL TRAINING FOR IRON AND STEEL WORKS

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Abstract: The model of academic personnel training for iron and steel industry is proposed based on global trends in education considering the existing business opinion on required competencies of university graduates. The paper raises issues concerning planning of educational programs for research workers at the levels of bachelor's, master's and doctor's degree programmes, and interpretation of concepts, such as a problem, basic training, and a competency.

Keywords: competencies, model of a university graduate, model of academic personnel training, stuff preparing for iron and steel works.

1 Introduction

In the light of contemporary global trends of technological advancement and transformation of educational environment, business and industrial metallurgical corporations are encouraged to reconsider their approaches to requirements and results of specialists' education [1 – 5].

Economy digitalization – creation of 'an industry digital twin' – takes place within the framework of technological development. Information technologies penetrated into various industries and fields so deeply that ceased to be a science but became tools used in all areas, including sociological and humanistic spheres. Digitalization influences the standing of industry, science and education leaders in the market – in today's business, those who own data take everything.

Information technologies are used in the iron and steel industry in the areas of 'big' and 'long' data analysis and processing, predictive analytics, prediction of product properties, technology design, and applied programming [6 – 13].

Speaking of global transformation of education, the following facts and situations can be observed:

- fiercer competition between employers for 'talents'
- involvement of employers into evaluation of learning results
- advantage of 'practitioners' over 'theorists'
- education globalisation – classification and integration of higher educational institutions, opening of representative establishments of large universities all over the world
- orientation towards training of world-class experts
- creation of a single global base of university graduates
- geographical shift of educational markets: about 1.5 bln people will be studying in Asia by 2025
- movement of education into the network, reduction of the university value as of the physical space
- competition between universities for resources and selection of resources from all over the world
- origination of zones of elitist education within mass education in universities
- receiving of diplomas by those students who created start-up at the end of education
- loss of higher educational institutions to R&D-centres and corporate universities in intellectualization

All universities without any exception shall compete with each other and with corporate universities, creating elitist and unique educational systems and environment. What is a modern employer waiting from an elite graduate?

2 The Model of a University Graduate for Business.

A simplified model of a graduate is given on Figure 1. Why is the form like this? The answer is very simple. A wonderful epoch of Einstein is over, natural sciences converted into polyparadigmatics; the systematic approach burst being replaced by the complexity theory due to the lack of knowledge of boundaries of the systems studied.

Every modern employer is sure that it needs people with formed 'hard skills' and 'soft skills' [1, 14 – 17], and the more skill a specialist has the better it is. However, it is not clear how to evaluate soft skills acquisition, how and when they are formed in the process of education.

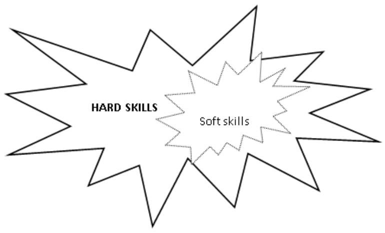

Fig. 1. A Simplified Model of a University Graduate

When developing iron and steel companies, one should rely on scientific personnel – extraordinary unique specialists who are graduates of elitist educational programs offered by universities. It should be noted that one of the challenges of modern universities and education is lack of standardization principles. It means that before providing the service to the user it is not known what quality and completeness the service would be.

In case if a list of competencies determined by business for academic personnel is known, then the task of a university is to answer the question 'How shall a specialist requested be trained?'

Instead of this, many universities start to formulate together with metallurgical companies more and more competencies of future elite academic personnel, assuming that the more competencies are put the higher will be the quality of a specialist. That is they make a typical mistake (Fig. 2): if the task of a subject is to jump over a precipice to the other side, in order to solve the task they start mistakenly to describe the other side instead of developing a new way of crossing.

In the situation described above, development of approaches to planning of educational programmes for academic personnel training is of great relevance. However, before representation of key planning ideas, it is necessary to evaluate special features of modern applicants for higher education and graduates of elitist programmes.

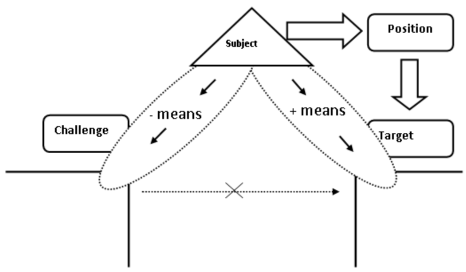

Fig. 2. Schematic Representation of Problem Solving

We have the younger generation who does not want to go to school and study at universities. They build levels in Minecraft, but have competencies of the future received in the on-line environment. If approaches to creation and organization of an educational process are not reviewed, current universities are risking to eradicate interests and talents of entrants. Business is also in a similar situation, as it is demonstrating students its worst production practices.

Graduates of university 'elitist programmes' shall understand that they will get a job in corporations or in the system of public affairs for sure, and only in this case a university will be a system influencing society changes, and it will be investing into educational elitism.

3. Planning of Educational Programmes for Academic Personnel Training.

When developing modern programmes for academic personnel training for production facilities, any researcher, head of a university or an industrial enterprise asks himself or herself the following questions:

1. In what area shall an educational activity be performed? For which tasks?
2. What markets shall be entered?
3. How shall one organize an educational process?
4. How shall one evaluate and monitor the results of an educational process?

Answering the first question, several problematic situations shall be formulated:

- a task-based approach prevails in university studies; there are no formulations and analysis of actual scientific problems
- a 'life tube' of an academic researcher is a pre-set trajectory
- a practice of copying others is popular: 'if we follow the Harvard's model, we will become it' despite the fact that there is a concept of 'reverse engineering' in technology – imitating, we copy not creating anything new
- training in problem- and solution-focused thinking is missing in education

When training academic personnel, the focus should be on consideration of inter- and multidisciplinary problems and tasks, for example: technologies of metallurgical enterprises and IT; CAE and CAD and electrical technology; economy, organization management, programming and IT, predictive analysis; CAE and CAD, IT, equipment reliability, diagnostics and predictive analysis; control system, process engineering, predictive analysis.

A discipline related circle with the centre of sciences intersection shall be formed at universities, and specialists shall be trained there for solving tasks, which have not been solved yet.

Answering the question 'What markets shall be entered?', some universities together with business start to study trends and markets discussing which place their university, graduates and specialists would take in the competitive environment, start to develop strategies and perform other managerial operations. Curious what market did Steve Jobs study, when there was no market of the product he was developing?! He imagined it, made it up! In the modern world, it is not people who compete, but systems, schemes, and finances. Universities shall compete only for future; they shall verify their each step with the 'future'.
The question 'How shall one organize an educational process?' is obviously the principal one in the process of academic personnel training. It has no universal answer. Figure 3 schematically shows a possible model of academic personnel training.

The suggested model is based on the 'base block'. It cannot be universal, and each university has its own original approach to basic training. For example, nowadays, programming can be the first knowledge in universities. Learning about world issues, application of mathematical methods for solution of engineering tasks, and study of physical processes in technology are also relevant.

The base block has to include mastering of competencies for project activities, case-method, time-management, and structural linguistics. The best way to plan an educational program is to combine educational methods.

The block of variable trajectories is used for 'pumping' students within a certain topic, task, or project. At this stage, it is required to put together a team of like-minded people with a leader-scientist in the lead and an expert-consultant from a production facility. In this block, students shall independently and pro-actively navigate in the most relevant and prospective suggested topics of research and developments. Talents and leaders are identified as a result of training; skills of independent team work are acquired.

The 'multifunctional block' is purposed for students to acquire additional competencies, which would let them implement projects at the interdisciplinary level, approaching the problem to be solved from different directions. For example, it is reasonable for a specialist in metallurgical technologies to go into automated systems and power engineering; it will be useful for specialists in metallurgical equipment to study problems of electrical drives and reliability; as mentioned above, it is mandatory for specialists of all categories to study issues of big data analysis and processing and predictive analysis.

The suggested model of academic personnel training, shown schematically on Fig. 3 and described above, is referred to the basic bachelor stage of training.

If the next stage of academic personnel training – the Master's degree program usually taught for 2 years – is considered, its schematic model will look slightly different (see Fig. 4).

A graduate student shall be 'pumped up' with the theory of the basics within the chosen training direction during the first year of education. The student shall study enough of domestic and international scientific papers made in the form of publications, monographs, etc.

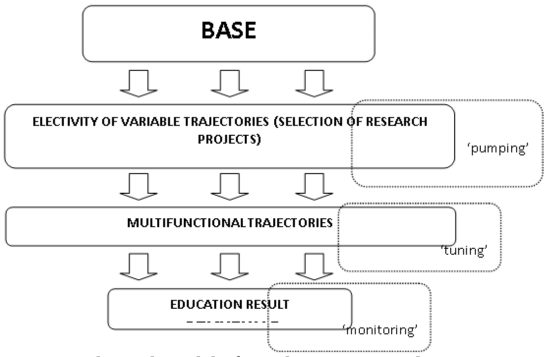

Fig. 3. Conditional Model of Academic Personnel Training

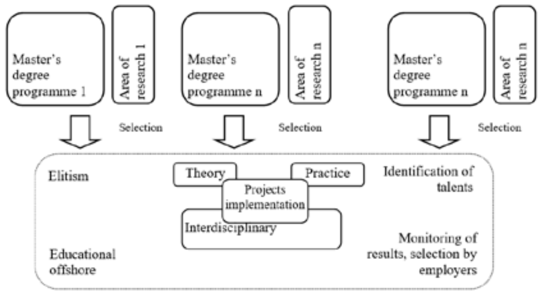

Fig. 4. Schematic Model of Students Training in the Master's Degree Programme

One of the problems all universities encounter is organization of acceptance control of applicants. Factors certainly influencing formation of an initial team of students of an educational programme and technically being difficult for expert evaluation are motivation, the depth of understanding of existing scientific problems and tasks, ability to find, formulate and understand the importance of the research project results.

In this respect, 'elitism' and a unique nature of the Master's degree program shall be determined not only by an education programme itself, its name, content and/or teaching specialists-experts, but educational trajectories (a unique environment, an area), which can be implemented during the second year of education. In this case, after studying the basic theory and determination of research directions, the students are offered to continue education in so called 'educational offshore' — a place where graduate students of different directions can implement interdisciplinary research projects. Creation of specialized laboratories, work spaces, and availability of highly-qualified academic-teaching staff is required for the education offshore.

Such organization of Master's degree programmes helps to identify talented students and teaching staff capable to set scientific tasks, discuss and determine scientific problems. The results and process of education in Master's degree programme according to such scheme will be of the most interest to potential employers.

Speaking of academic staff training at the last education stage — the Doctor's degree programme, certain gaps in the university educational system shall be noted.

Usually, in postgraduate programmes modern universities are bringing up researchers-performers who can, at a high level, prepare publications for top-rated magazines, make reports at conferences of different levels, who deeply understand existing scientific problems and mechanisms of organization and control of research activity. However, doctor's degree programmes do not provide formation of such category of scientists as Principal Investigators. Alumni of post-graduate programmes are lacking independence, ability to form networks of scientific contacts, organize solution of scientific tasks and project, prepare applications for grants. This fact negatively influences the formation of 'scientific leaders', appearance of new areas of knowledge in various fields, including iron and steel industry.
A postgraduate student is an individual product in science, having passed through several procedures of evaluation and sorting out at stages of bachelor's and master's degree programmes, therefore, an educational programme shall be formed based on the model of alumni (Principal Investigators), or based on formats of scientific work.

Fig. 5 provides a model of postgraduate student training. Compared to the Master's degree programme, the model is focused on one subject — a learner, rather than on a group of students. An education program might consider the following situations: only a student having its own research topic can enter a Doctor's degree program; upon admission, a postgraduate student is offered to solve scientific tasks at his/her discretion; a postgraduate student is offered to work in a team of researchers to solve an interdisciplinary task similar to the model of graduate students training discussed above.
When considering the question 'How can one evaluate what has already been taught?' there can be used both well-known monitoring methods, for example, tests and exams, or other approaches:

- evaluation of a cognitive style of a student (what he/she was like at the entry, and what he/she has become at the exit)
- evaluation of the project in general by the principle 'implemented' / 'not implemented'
- creation of a masterpiece, start-up, etc. by a student

Despite various approaches to evaluation of education results, the main result and the goal of researcher training is to 'create'.

Currently, HR-managers all over the world are seeking to formulate and evaluate competencies of employees of industrial enterprises [18 – 23]. Based on the suggested approach it can be concluded that a 'competent specialist' is a person, who is given a task, and he/she has qualification to perform this task; a 'competency' is a capability of a person (a subject) to participate in transformation; a competency belongs to a university alumnus, or a specialist.

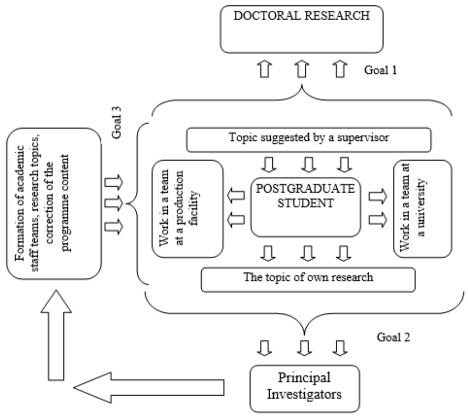

Fig. 5. The Scheme of the Postgraduate Students Training Model
In considered schemes and approaches, a university shall be an operator of a solution, a development unit focused on preparation to statement and solution of scientific problems.

Conclusions

Any actively developing iron and steel company is committed to development of own elitist research and engineering personnel, and, consequently, it needs methodological, expert, organizational and technical support from universities.

When planning and implementing organizational programmes correctly, universities can ensure the development of industrial partners, since the development is planning of an object by a subject (a student, a researcher) in an area new to him/her. A subject cannot develop independently. He/she can only arrogate the results of the development of the system he/she is in.

During an epoch, when economy is based on knowledge, a university shall be a place for 'thinking', it shall change a person's thinking, generate ideas, perform valorization and develop approaches to implementation of changes, be in the environment, where 'new knowledge' is created, and create such environment by itself.

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