

# Proven Collaboration between JSC TomskNIPIneft and Tomsk Polytechnic University in Training Today's Petroleum Engineers

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The issue of the day is «What new means and programs could be considered in training today's petroleum engineers?» Analyzing the experience and enormous efforts of one R&D Institute and design office, new concepts and approaches are being discussed in the design and development of effective programs for personnel training.

**Key words:** design, project conception, competencies, institute, personnel training, high educational establishment, engineering education.



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## **Personnel Issues in Modern Petroleum Enterprise.**

During the past few decades, JSC «TomskNIPIneft» Institution like other similar Russian petroleum institutions is subjected to a shortage of highly-qualified engineering personnel. Today's engineering world embraces such growing requirements as teamwork abilities, multidisciplinary knowledge in different science branches such as field exploration and development, skills in analytical and project drafting and simulation methods (modeling), flexibility and mobility, management of sophisticated software programs. According to some experts in its entirety technology and information significantly speeds up the process of «knowledge ageing.» Science and technology progress at such a rate that existing engineering resources date

rapidly up to 20% annually [1]. Sophisticated production technology, new requirements in reservoir engineering promotes the problem of training and re-training personnel. Today's professionals should be self-oriented in their constant training and re-training.

## **Major Engineering Competence Development Trends within JSC TomskNIPIneft.**

To maintain recruitment needs, including the development of the Institute in furthering the enhancement of oil production in perspective Russian regions, one should invest not in short-term training courses, but in the implementation of the target education background for one's personnel in close collaboration with different universities and institutes.

JSC TomskNIPIneft is the easternmost institution in western Siberia implementing the following integrated cycle: research project → institution → petroleum enterprise. Present work targets only embrace such aspects as reserve calculations, reservoir engineering design documentation, reconnaissance and project engineering in infrastructure sites, including environmental protection and efficient nature management.

In the 90s of the last century JSC TomskNIPIneft directed all its facilities and resources into the eastern regions of Russia – Kamchatsk oblast. Profitable natural gas supply facilities were designed here, including the pilot production of two gas-condensate fields (Kshuusk and Kvakchinsk) and more than 400 km-pipeline throughout Kamchatsk oblast.

Operating in these eastern regions involved challenging problems furthering new experience and associated competencies. For example, the construction of Kamchatka gas pipeline in seismic hazard zone (up to 10 on Richter scale) required the application of special engineering structures for buildings and facilities. This project included new engineering construction design and specific technical requirements in accordance to State legislative documents. Since 2007 the Institution has been implementing significant engineering construction design of production facilities for Urybcheno-Tokhomsk, Vankorsk and Verkhnechonsk fields.

Operating in eastern regions, the institute developed contemporary engineering competencies, especially conceptual engineering and technology in Facilities Design Construction (FDC). During the past few years, the Institution has completed 19 feasibility studies, the most significant of which are: «Integrated concept-program in gas utilization and gas transport-system development within Krasnoyarsk territory and Irkutsk oblast» and «Strategies in further development of helium industry within helium-rich fields of Eastern Siberia».

Engineering design of production facilities in Urybcheno-Tokhomsk

field and pipeline construction from the above-mentioned field to Taishet highlighted the relevant development of engineering competencies of production facilities design in complicated conditions. For example, such factors as FDC in permafrost zones, significant elevation differences along the northern pipeline section, limited underwater pipeline lying through Angara and Birusa Rivers.

Rapid performance activities resulted in the implementation of principles and engineering competencies in project management. To implement the project management principles an organization framework was developed within the institution, named as project engineering office. These offices embraced various functions in project management, i.e. the management and control of such project aspects as the project itself, basic technical requirements, optimal project life, quality performance, project cost, human and material resources and risk management. The after-effect of such reorganization was the further retraining and advanced training of in-house specialists. During the past few years, the above-mentioned development of engineering competencies affected only some competency aspects of this institution. These issues could not have been solved without personnel planning management and the close collaboration with NR Tomsk Polytechnic University.

#### **Collaboration Model Outline between Enterprises and Universities.**

There are different collaboration models between petroleum enterprises and universities, such as internships, recruitment activities, financial support, i.e. equipment procurement, grants, scholarships, etc. However, the dimension and influence of such collaboration on the academic activities of this or that university is insignificant, especially the possible up-dating of present curriculum programs in training and retraining of future specialists. JSC TomskNIPIneft is developing not only the traditional training methods, but also implementing different integrated curriculum projects.

A striking partnership project example is the Petroleum Learning Centre (PLC), Heriot-Watt University and Tomsk Polytechnic University, existing for more than 10 years within the Common Education Space. This Center implemented the modern education approach- integrated academic activities in the professional training of petroleum enterprise personnel through international education projects. Such a project reflected the growing demand in professionals for Russian petroleum enterprises, furthering their interest in relevant education level and readiness to financial support. JSC TomskNIPneft actively participated in the early establishment stages of this Centre: transfer of personnel to Tomsk Polytechnic University and design of study manuals for the 3rd and 4th program- terms. The academic project course includes 4 terms, the first 2 of which involve basic training courses in geology, petrophysics, exploration, development and production, drilling, field infrastructure development and economics [2]. Learning activities in above-mentioned disciplines are performed in computer classes through sophisticated software programs. In the third term (April-June) students perform individual research projects related to case studies in field exploration and development. During the 4th term (July- September) the students work are in multi-disciplinary teams to perform case-study projects in actual oil field development. Such case-study projects promote the ability to design geological and hydrodynamic models of an oil field, estimate various field development models, evaluate the development impact on environment and apply modern economic analysis in selecting the optimal development model for this or that oil field. These study manuals for experimental academic sessions were designed by a group of active department personnel of JSC TomskNIPneft, who are still cooperating with this Center today.

#### **Human Resource Issues.**

JSC TomskNIPneft has up-dated its strategies in selecting and training new professionals in view of the policy of many governmental and organizational frames. This policy includes the promoting and furthering of bilateral relations with different Tomsk universities, especially NR TPU, the graduates of which comprise more than 50% of the institution's engineering personnel (Table 1).

As mentioned above high non-standard requirements are being imposed on the specialist of JSC TomskNIPneft. The following fact highlights this aspect- «green» junior engineer personnel by no means always stand the «ideal employee» which the employer would like to see and have. According to the latest management questionnaire (2011), more than 50 questioned manager-supervisors characterized yesterday's graduate and today's junior engineer as having average knowledge and skills (Fig.1). According to the 5- grade scale an average university graduate cannot even achieve «four» in the key requirements of the employers, if not to mention other specific requirements.

The following fact should also be mentioned- the institution in-cooperated a rather rigid individual selection of young skilled personnel among graduates of university-partners.

Nevertheless, the professional qualification of graduates in many cases depends on this or that specialty, department, and university and student participation in different research projects. Within the framework of the above-mentioned questionnaire, the graduates of PLC showed significant performance skills. However, this highlights the fact that there exists a stable tendency in today's universities - graduates study only within the frame of standard curriculum, without considering the realities of modern production. Such curriculum includes only one specialty with a set of integrated disciplines, excluding a distinct correlation to in-situ conditions. Existing curriculum programs are theoretically over-elaborated and oriented on «stale» academic standards.

**Table 1. Number (percentage) of graduates included in JSC TomskNIPIneft personnel**

University (Institute)	Number of personnel	Доля, %
National Research Tomsk Polytechnic University (NR TPU)	354	51
National Research Tomsk State University	125	18
Tomsk State Architecture-Building University	112	16
Tomsk Control System and Radio-Electronics University	21	3
Tomsk State Pedagogical University	7	1
Others	76	11

The above –mentioned factors have serious consequences:

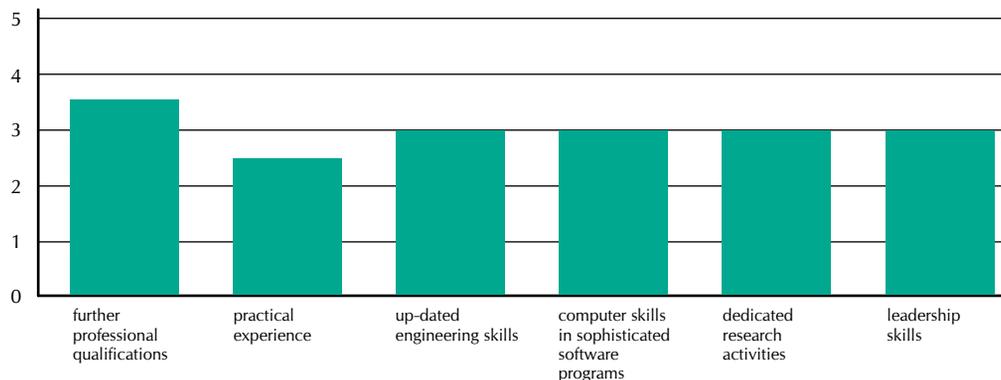
- a graduate-specialist needs to adapt himself/herself to the current job requirements and this takes time;
- lack of time and efforts results in an unsystematic assimilation of up-dated knowledge, i.e. «on-the-go» knowledge («a little bit here and a little bit there»);
- newcomer-specialist has neither time nor possibilities to enhance his/her knowledge and skills in production-technology and standardized and even inflexible thinking is oriented only on specific task-solutions (sector, group or department).

Such consequences involve negative tendencies and risks within different production sectors as the isolation of various departments furthering the development of optimal solutions only within this department. Such «optimal» solutions could not only negate the stated task in general but also the production target of the enterprise itself.

**Decision System Development in Human Resources between NR TPU and JSC «Tomsk NIPIneft».**

Based on a detailed analysis of the above-mentioned factors, the following target goal was established to improve the performance efficiency of the institu-

**Fig. 1. Performance quality assessment of employed graduates (2009-2011)**



tion project departments- significantly update multidisciplinary engineering knowledge level and develop integrated teamwork. This includes the organization of engineer-teams within each department to develop not only optimal, but also integrated project decision results, evolving the limitation and possibilities of these departments.

Implementation tools involved the project target development strategies in personnel training for the Department of Infrastructure Development. The mission of «INFRASTRUCTURE DEVELOPMENT PROJECT» (herein referred to a «Project») includes the following: «Training specialists having such qualities and traits as deep knowledge and experience, teamwork skills, integrated competencies in surface infrastructure development of oil & gas fields to significantly improve the project quality and performance rate, increase labor productivity and upgrading gain, as well as, to minimize possible risks in project management».

The Project was implemented within the learning module framework of NR TPU. Not only experts from JSC «Tomsk NIPIneft», but also professionals from such institutions as PLC Center, National Research TPU, Tomsk Control System and Radio-Electronics University, Ufa State Petroleum Engineering University, and other consulting companies have been involved in this project-program development and implementation (Fig. 2).

This Project includes such technological modules that develop not only management skills, but also computer skills, i.e. application of sophisticated software programs in different activity areas. Such a wide scope of knowledge and skills furthers the understanding of those production possibilities and limitation within related departments.

The Project includes 12 technological and 10 management module courses, all of which are based on such learning tools as lectures, problem-solving discussion in groups, panel discussion, teamwork activities, contingency models, stimulation games and autonomous learning. The Project module structure

involves two types: (1) short-term out-of-job training from 6 to 10 days (i.e. 48-72 hours) and (2) intensive self-education on-the-job training. The content and pattern information of autonomous learning within the framework of this Project is depicted in Table 2.

Control measurements within each module include two or three types, such as exam, mini-project, term paper or supervision of professionals from different enterprises. These control measurements involve either written format or paper presentation with a representative Institution Examination Board.

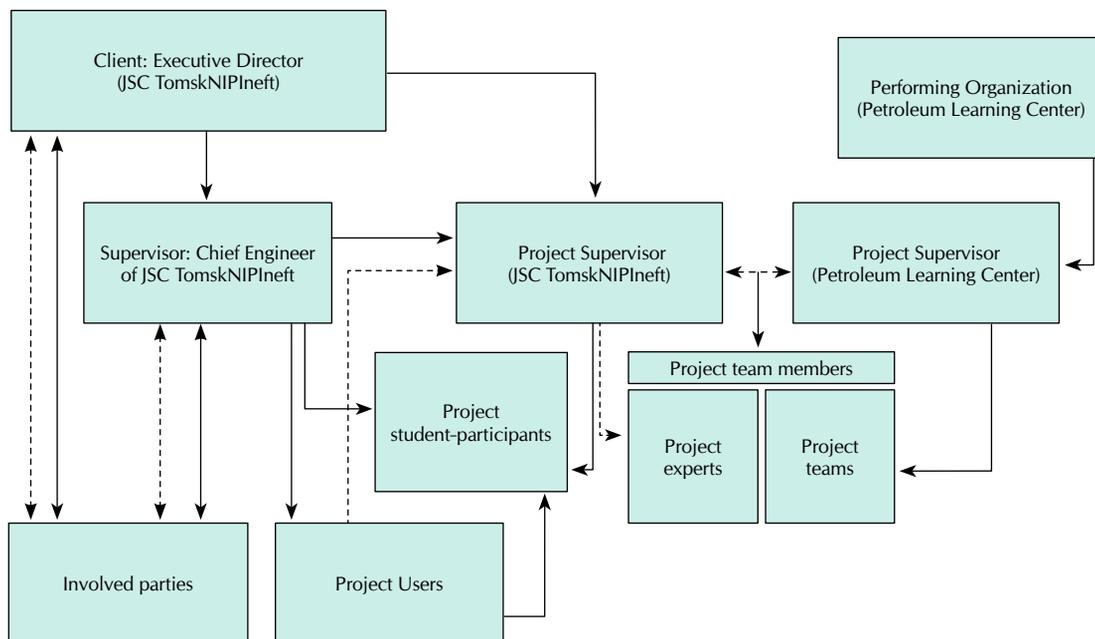
To evaluate the employee's integrated knowledge and skills in design & construction of production facilities, an innovative learning tool was proposed- project teamwork. The project teamwork involved a problem-solving situation- new undeveloped oilfield. The project task is to develop design & construction of production facilities of an oilfield, including its further perspective development. Within the framework of this project the team fulfills the following task items:

- Engineering design concept of production facilities construction and process development work (PDW) protection;
- Design study and survey procedure;
- Engineering design of basic project exposure draft (ED);
- Engineering design of project plan progress.

During the project design the team members work out the following problem solutions:

- site location and dimension of production units;
- well production pipeline transportation;
- crude product export;
- hydrocarbon process system;
- reservoir pressure maintenance system;
- application of associated gas (LNG);
- related solutions in power supply, water facilities, drainage system,

**Fig. 2. Project-program development and implementation diagram**



- automatization, communications and others;
- economic assessment of suggested production facilities construction;
- risk evaluation;
- project stage activities schedule.

The Project is based on actual data and information of one specific existing oil- field. After fundamental training such an approach reveals the following possibilities as (1) on-site training and (2) teamwork result evaluation in comparison to existing and implemented production decisions.

In 2011 the first employee-team group in TomskNIPneft successfully completed their training course within the framework of this Project, and today the second team group is preparing their graduation papers. The second newly edited version of this Project was proposed in December, 2011. This new-version Project is termed as «Engineering Manager for EAD (Engineering & Design)».

Based on the Project result analysis the following diagram was plotted vividly showing the dynamic professional career growth of the first team-group. During 2008–2011 12 employees

**Table 2. Autonomous learning within the framework of the Project**

AUTONOMOUS LEARNING		
Price Model in EAD (Engineering & Design)	36	credit
HSE (Health, Safety and Environment)	36	credit
Principles of Design Documentation	36	credit
AutoCAD 2011 in E-learning format	36	credit
MS-Project in E-learning format	36	credit
Introduction in Management	36	credit
Innovations in Petroleum Industry Sectors	72	credit

showed significant career growth in comparison to the ordinary development engineer (Fig. 3).

Due to the positive and effective results of the above-described project, this Development Engineering Training Project could be introduced into different petroleum companies as a key approach in training highly-qualified design engineers and development engineers for the oil and gas sectors

**Conclusion.**

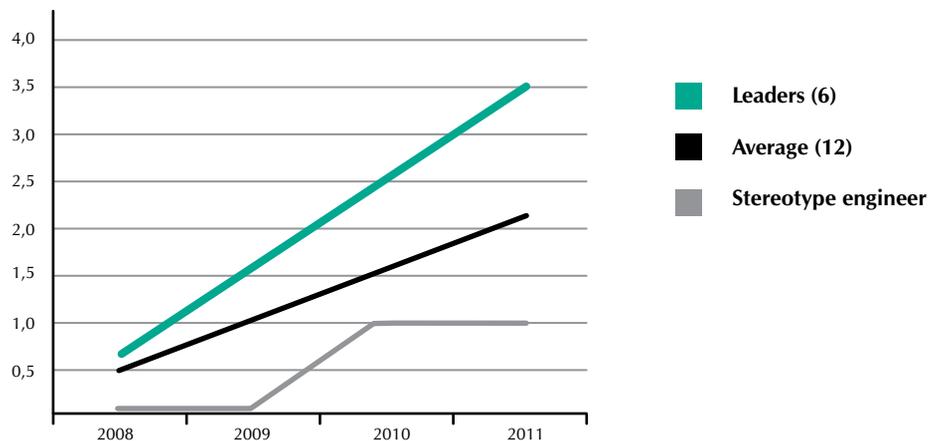
The development of an effective embracing engineering education system is one of the most vital problem-solving issues in many modern fuel and energy enterprise sectors of Russia.

Based on their experience in project strategy of engineering personnel training, the authors consider that highly-qualified engineering education should provide not only theoretical knowledge, but also those practical skills and abilities that are essential for any graduate i.e. future engineer. The solution is in

the integrated collaboration between enterprises and different universities and institutions. The foregoing tasks should include the implementation of integrated projects in personnel training and further the development of expert training teams in enterprises which would use own resources in future engineering training. Such a mid-term systematic approach being implemented in different enterprises would allow not only to train highly-qualified engineers, but also enable them to work in complicated conditions of uncertainty, elaborate various branches of knowledge furthering one's skills and abilities in practice, as well as, improve one's skills in sophisticated IT and advance one's knowledge in challenging petroleum business technology.

The implementation of contemporary project management strategies into enterprises as a «new philosophy» in training today's petroleum engineers could be that «lever» which would retain and enforce their competitive position in the petroleum engineering market.

**Fig. 3. Dynamic career growth curve of Project participants**



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