# Education for high-tech chemical industries: TSU experience

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TSU: one of the five best classical universities in the country and the five best universities of the Russian Federation according to the QS rating of the BRICS countries, more than 15 thousand students, 20 faculties and institutes, 66 - world-class laboratories, Shared Centers, Engineering Centers. There are more than 100 high-tech companies - partners of TSU. Annually Tomsk University (TSU and TPU) graduates about 300 chemists (about 1000 people have been trained). QS "Chemistry" 300-400, QS Chem. Eng.200-250.

The main programs for the training of scientific personnel in the chemical profile in TSU are: "Chemistry" (04.03.01, "Chemistry"), the beginning of training in 1998; "Fundamental and Applied Chemistry" (04.05.01, "Fundamental and Applied Chemistry"), the beginning of preparation from 1932; "Fundamental and Applied Chemistry of Substances and Materials" (04.04.01, "Chemistry"), the beginning of preparation since 1998; "Translational Chemical and Biomedical Technologies" (04.04.01, "Chemistry") from 2016 .

Strong training in fundamental and applied chemistry has always been a competitive factor for our graduates. Currently, this is not enough for employers - high-tech companies in the chemical industry. The main problem is the inconsistency of graduates with the professional requirements of high-tech industries (lack of digital competencies, design thinking, adaptability to knowledge in other areas). Companies solve the problem of “finishing education” in different ways: through corporate training centers, targeted programs in universities, internships. The gap in the University system - a high-tech company is growing rapidly. The reason for this is the rapid change in the technological structure and the growing interconnection of technological chains with environmental risks, consumer preferences for utility, functionality and safety. The education system does not keep pace with the development of technologies; the basic technologies in the educational system have not changed for decades. This situation poses a task for the Russian education system - to transform not only educational content (computer modeling, chemical engineering), but also to form, together with partners, an environment for involvement and adaptation to future professional activities.

TSU case (network - additional professional training (APT)): the educational module of TSU was developed and implemented as part of the network program with SIBUR (https://www.sibur.ru/en/) "for a selected group of senior bachelors and masters of TSU and TPU, on-line defense of industrial cases were carried out with the consulting support of SIBUR experts during the COVID19 pandemic. On the one hand, the result can be assessed positively; on the other hand, interuniversity educational practice shows that the network format of master's programs and continuing education programs is still heavy for administration and inert to changing requirements of modern industries and technologies. The next stage: development of a network Master's program in Chemical Engineering with the participation of foreign partner universities and internship modules at SIBUR sites. Scheme of training cycle at the request of enterprises of the SIBUR holding.

TSU case (cross-modules): At TSU, open cross-disciplinary modules "Quantum" and "Molecular biology" have been developed and successfully implemented on top of the OPP as part of key disciplines and practices that allow students of different directions and level of training to quickly master basic knowledge and digital tools for their practical application (quantum mechanics, quantum computing, molecular biology, molecular modeling). The draft regulations for the cross-module have been developed, which, in our opinion, will be in great demand by the University of Tomsk, other universities, as well as industrial partners of universities.

**Conclusion.** High-tech companies, as a rule, are included in the training of specialists in the last years of the bachelor's or master's degrees, when there is a professional specialization. They are not interested in investing at an earlier stage, but both the university and the employer are interested in the graduate's success in the workplace. This means that we need to work on this success together, in the full cycle of training a specialist from school to professional maturity, in flexible formats.