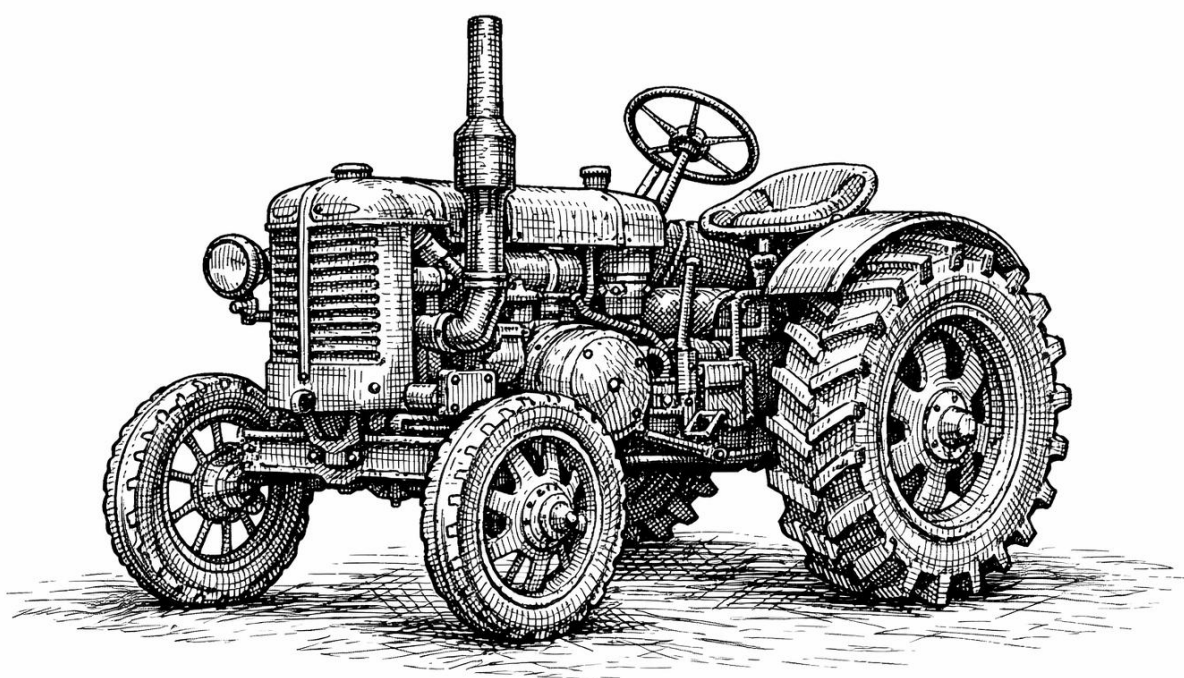


AGRICULTURAL MACHINERY IN THE CZECH LANDS: TRADITION, INDUSTRY AND SMART TECHNOLOGIES



INTRODUCTION

Agricultural machinery played a key role in the history of Czechoslovakia in transforming traditional agriculture into a modern and productive sector. This development was built directly on the technical and industrial legacy of Austria-Hungary, within which the Czech lands belonged among the most advanced regions of the entire monarchy. Bohemia, Moravia and Silesia formed the industrial core of the empire, with a high concentration of mechanical engineering production, technical education and skilled labour.

At the turn of the 19th and 20th centuries, the region had not only a strong tradition of manufacturing agricultural machines, but also advanced technologies for processing agricultural products. Breweries, sugar factories, distilleries, mills and cider plants played a significant role and ranked among the most technologically advanced enterprises of their time. The Czech sugar industry had already reached a leading European level before 1918, and brewing became a symbol of both technical sophistication and product quality. These operations used steam engines, later internal combustion engines, sophisticated material-handling systems, and, gradually, also the first elements of automation.

The establishment of independent Czechoslovakia in 1918 enabled further development of both agricultural mechanisation and processing technologies. Tractors, threshers, sowing and harvesting machines fundamentally changed primary production, while modernised processing plants increased the added value of agricultural products.

After World War II, this development was further accelerated as part of agricultural industrialisation. A symbolic culmination of this technical continuity was the company Zetor, whose tractors became the backbone of domestic agriculture and an important export commodity.

AGRICULTURE AS PART OF THE AGRO-INDUSTRIAL COMPLEX

Agriculture in the Czech lands and later in Czechoslovakia never developed in isolation. Already from the late 19th century, it formed an integral part of a broader agro-industrial complex that connected primary production in fields and livestock farming with processing industry, transport, energy and mechanical engineering. This interconnectedness was one of the main sources of the high productivity and competitiveness of Czechoslovak agriculture.

The foundation of the agro-industrial complex was technological continuity across individual production stages. The production of cereals, sugar beets, hops, potatoes, fruit, or milk was closely linked to mills, sugar factories, breweries, distilleries, and cider plants. These facilities belonged among the most technologically advanced enterprises of their time: they used steam engines, later electric motors and internal combustion engines, conveyor-based material transport, centrifuges, presses, boiling apparatus and, gradually, the first automation and measuring systems. The processing industry thus created a stable demand for agricultural raw materials and, at the same time, influenced the structure of cultivated crops.

The development of agricultural technology—tractors, seed drills, combine harvesters, and the mechanisation of livestock production—cannot be separated from the requirements of processing plants for volume, quality, and the regularity of deliveries. Technological innovations in these fields enabled higher yields and the standardisation of production, which was essential, especially in sugar production and brewing, where raw material quality was decisive.



After World War II, the agro-industrial complex was further developed within the centrally planned economy. Although this model brought a number of organisational problems, the technical linkage between agriculture and the processing industry remained preserved. Large integrated operations were created that combined agricultural production, storage, processing and distribution. The agro-industrial complex thus represented one of the pillars of the Czechoslovak economy and contributed significantly to rural development, technical education and the country's export potential.

The development of processing technologies for agricultural products was among the most important factors shaping modern agriculture in the Czech lands and later in Czechoslovakia.

Already in the Austro-Hungarian period, a dense network of sugar factories, breweries, mills and other processing plants developed, technologically comparable with the most advanced enterprises in Western Europe. This industrial base created strong ties between primary agricultural production and downstream industry—ties that persisted after the independent state was established in 1918.

Sugar production played an exceptional role, especially through sugar beet cultivation, which required precisely timed harvesting, rapid transport, and efficient processing. Sugar factories used advanced technical equipment such as diffusers, vacuum evaporators, centrifuges and steam drives, and later also electrified and partly automated production lines. Requirements for raw material quality significantly influenced agricultural practices, mechanisation of harvesting and crop breeding.

Similarly, brewing combined traditional knowledge with modern technology. The cultivation of malting barley and hops was closely linked to technological development in malt houses and breweries, where closed brewhouse systems, cooling equipment, controlled fermentation, and precise measurement of process parameters were gradually introduced. Breweries thus became important industrial enterprises contributing to the technical development of regions and to the international reputation of the Czech lands.

An inseparable part of this system was also the development of storage and drying technologies. The construction of grain silos, dryers, cold stores, and specialised warehouses enabled the reduction of post-harvest losses, stabilisation of raw-material supplies, and the continuous operation of processing plants. The gradual introduction of mechanised aeration, controlled drying and moisture monitoring represented an important step toward a modern agro-industrial complex that significantly contributed to the economic stability of Czechoslovakia.

MANUFACTURING OF AGRICULTURAL MACHINERY AND TECHNOLOGIES IN CZECHOSLOVAKIA

The development of agricultural machinery in the Czech lands and later in Czechoslovakia was closely linked to an exceptionally strong engineering tradition, which had already been formed in the 19th century and further developed during the Austro-Hungarian period. On this foundation, a number of companies emerged that were able to succeed not only on the domestic market but also abroad, and that significantly influenced the mechanisation of agriculture in Central and Eastern Europe.

The most important and internationally most successful tractor manufacturer is Zetor, founded in 1946 in Brno. Already the first model, Zetor 25, was characterised by simple design, high reliability and easy maintenance, making it an ideal machine for post-war agriculture. Zetor quickly became a symbol of Czechoslovak agricultural engineering and its tractors were exported to dozens of countries worldwide, where they gained a reputation as robust and versatile machines.

An important role in the interwar period was played by the company Wikov (Wichterle & Kovářík), which belonged among the largest manufacturers of agricultural machinery in Czechoslovakia. In addition to ploughs, seed drills and threshers, it also produced tractors, including the well-known

Wikov 32. The company's production was distinguished by a high technical level and quality workmanship.

Another key player was the engineering conglomerate ČKD, which, besides heavy industry, also manufactured tracked and wheeled tractors and specialised agricultural machines. Thanks to strong technical capacity and experience in producing engines and transmission systems, ČKD contributed to the development of more powerful mechanisation intended for large agricultural enterprises.

Škoda also left its mark on the history of agricultural machinery: in the 1940s and 1950s, it produced tractors and engines, for example, the Škoda 30 type. Although agricultural machinery was not the company's primary focus, the technical quality and industrial precision met the brand's high standards.

A specific place was held by the smaller company Svoboda, which focused on simpler and more affordable tractors for smaller farms. These machines contributed significantly to the gradual mechanisation of the countryside, especially in the 1930s.

Alongside tractor manufacturers, many enterprises in Czechoslovakia also specialised in threshers, seeders, mowing equipment, stationary engines and machinery for processing agricultural products. Together, these companies formed a strong and technologically advanced sector capable of covering the needs of domestic agriculture while also successfully competing in foreign markets. This combination of technical quality, industrial tradition and close connection with agricultural practice represents one of the most valuable legacies of Czechoslovak engineering.

THE PRESENT DAY

Contemporary Czech agricultural machinery builds on a long tradition of domestic engineering; however, its character has changed significantly since 1989. The sector gradually shifted from mass production of universal machines toward specialised solutions, higher added value and close integration with research, development and digital technologies. The Czech Republic continues to maintain a strong position, especially in the design of robust and technically well-conceived machines that find applications not only in the domestic market but primarily abroad.

The most important bearer of historical continuity remains Zetor, which is still the only Czech manufacturer producing tractors in larger series. Modern Zetor tractors meet strict emission and safety standards and integrate electronic control systems, while preserving a traditional emphasis on ease of maintenance, mechanical reliability and long service life. These characteristics enable their use even in demanding operating conditions outside Europe.

Beyond tractor production, a number of Czech companies have established themselves in soil cultivation and seeding technology. Bednar FMT, Farmet and SMS CZ belong among the important exporters of modern machinery for soil tillage and seeding, characterised by modular design, high field capacity and adaptability to diverse soil and climatic conditions. Forage harvesting and mowing technology is represented, for example, by Agrostroj Pelhřimov, while OPaLL-AGRI and AGP focus on application technology, especially spreaders and sprayers.

An important part of the current Czech portfolio also includes technologies for post-harvest processing, storage and drying of agricultural products. Companies such as Agroing and JK Machinery supply complex systems for grain handling, silos and dryers, increasing the efficiency of the entire production chain and reducing post-harvest losses.

A growing role is played by firms focused on precision and smart agriculture. Companies such as Leading Farmers CZ, GEOTRONICS Praha, Workswell and Kurent develop sensors, monitoring systems, drones and thermal technologies, and tools for digital crop diagnostics. These technologies move Czech agriculture toward data-driven farming and sustainable resource use.

A specific and rapidly developing area is robotics and autonomous systems, where smaller, highly specialised companies are also active—for example, ProLab Engineering, focused on developing autonomous and remotely controlled ground robotic platforms for agriculture and other applications. The current state of Czech agricultural machinery thus represents a modern, diversified ecosystem combining traditional engineering know-how with innovation and responding to the current challenges of global agriculture.

SMART AGRICULTURE – THE CZECH REPUBLIC AS A TECHNOLOGICAL LEADER

In the field of smart agriculture, the Czech Republic has long positioned itself as one of the technological leaders not only within the European Union but also globally. This position did not arise by chance: it builds on a strong engineering, electrotechnical and research tradition that has been systematically developed in the Czech lands for more than a century. While many countries adapt to the digitalisation of agriculture gradually, the Czech environment is characterised by the ability to actively develop, test and successfully export these technologies.

The Czech Republic excels particularly in precision agriculture, sensor technologies, data analysis, drone systems and autonomous ground platforms. Research institutions, in cooperation with technology companies, can rapidly translate applied research results into practice, enabling complex solutions that include crop monitoring, variable-rate input application, yield prediction and autonomous operation of agricultural machinery. A typical feature of the Czech approach is an emphasis on technical robustness, modularity and usability in different climatic and operational conditions, including developing regions.

A significant indicator of Czech leadership is also the strong export orientation of smart agricultural technologies. Czech solutions are applied not only across the European Union, but also in Asia, Africa and Latin America, where they are valued for reliability, ease of deployment and the ability to operate even where infrastructure is limited. In smart agriculture, the Czech Republic thus acts not merely as a user of modern technologies, but above all as an active creator and global supplier—confirming its position as a technologically advanced country with considerable international reach.

An important role in this position is played by outstanding higher education and research capacity. The Czech University of Life Sciences Prague is among the key European institutions in modern and smart agriculture. Several study programmes focused on smart and precision agriculture, agricultural robotics, digital technologies, sensor systems and automation of agricultural processes

are systematically taught there. These programmes connect engineering, agronomy and information disciplines and prepare professionals capable of responding to current and future challenges of global agriculture.

The international level of this approach is confirmed by the fact that the Czech University of Life Sciences Prague is ranked among the world's top 24 institutions in Agricultural Sciences. This ranking reflects not only high-quality education, but above all a strong orientation toward applied research, technology transfer into practice and close cooperation with industrial partners. The university thus significantly contributes to ensuring that the Czech Republic is not only a consumer of foreign solutions, but belongs among their active creators and internationally respected leaders.

A key factor further strengthening the Czech Republic's international position in smart agriculture is the systematic transfer of know-how from academia to industry and farming practice. Research results and technological solutions developed at universities and research workplaces are not confined to the academic sphere; they are purposefully translated into applications usable in real operations. This process includes contract research, joint development projects with companies, pilot testing directly on farms and the establishment of spin-off companies.

Thanks to close cooperation with industrial partners, there is a direct link between education, research and production. Students and early-career researchers participate in solving concrete technical tasks, while companies gain access to the newest knowledge in precision and smart agriculture, digitalisation, sensor systems, autonomous platforms and data-driven production management. This model enables rapid implementation of innovation in practice and simultaneously strengthens the competitiveness of Czech technology companies in European and global markets.

Technology transfer thus represents one of the pillars of Czech leadership in smart agriculture: the Czech Republic acts not only as a centre of top-level research, but as a functional innovation ecosystem in which knowledge is smoothly transformed into concrete technologies, products and services used in real agriculture worldwide.

CONCLUSION

The history of agricultural machinery in the Czech lands and later in Czechoslovakia shows exceptional continuity of technical thinking, industrial tradition and the ability to link agricultural practice with research and production. From the mechanisation of fields and the development of the agro-industrial complex, through strong domestic engineering represented by iconic enterprises, to today's digital and autonomous technologies, Czech agriculture has relied on innovation as a key source of competitiveness.

The current era of smart agriculture naturally builds on this tradition and develops it under new conditions of the global economy, climate change and the pressure for sustainability. Today, the Czech Republic stands not only as a bearer of historical legacy but also as an active creator of modern solutions applied at home and internationally. Agricultural machinery, therefore, remains one of the pillars of Czech technical identity—a bridge between the past, present and future of agriculture.