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ROLE OF ENGINEERS AND MILESTONES OF INDUSTRIAL DEVELOPMENT IN HUNGARY

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Abstract

The article is an overview of great ages in Hungarian industrial development. The Introduction highlights the development from handicraft to large-scale Hungarian industries, then industrial policy efforts of the 19th century are scrutinised. The Compromise of 1867 with Austria, the two world wars of the 20th century and the related peace treaties (Trianon, Paris) had a great influence on Hungarian economy and politics as well as industrial development. What were the Hungarian industrial achievements of the time? How did engineering education develop? What were the inventions and patents of Hungarian engineers that contributed to global technical progress? What was the effect of contradictory industrial policy after the Second World War as far as engineers and industry are concerned? These are the questions addressed in this article.

Keywords: handicraft, large-scale industry, industry development, technical culture, engineers, patents.

1. From Handicraft to Large-Scale Industries – Instead of Introduction

Industrial cultures played a determining role in the more than one thousand years of the Hungarian state, even if their efficiency and impact was different in different ages. These cultures were mostly adopted and developed further, especially in metalworking, weaving and spinning (GYŐRFFY (1997); FETTICH (1935)).

According to documents of the age, there was some kind of division of labour on latifundia of the 11th century; service-based settlements evolved: e.g. farming (arator), artisan-handicraft-iron (molendinarius, tributarius ferri, faber) villages. In the 12th century, there were three important centres of metallurgy in Hungary. The produced basic material (crude iron) and the manufactured final products (mostly agricultural tools) featured a buoyant international trade. The most demanded iron tools on the market of Gdansk were coming from Spain, Sweden and Hungary (LÓSY–SCHMIDT (1921); BÉKEFI (1891); HECKENAST et al. (1968)).

As it is well-known, manufacturing guilds evolved in the middle ages (as far as we know, the first guild certificate was issued in 1307 in Hungary). Technical development in the late middle ages and in the early new age was determined by historical events: Hungary was divided into three parts after the battle of Mohács (1526). During the wars of independence against the Turks, later the Habsburgs military technology and the related industries developed. Mining was important even before and during these independence wars (until the second half of the 18th century, only ores were mined. FALLER et al. (1997); GEORGIUS... (1994)).

The Universal Kommerz Directorium established by Queen Maria Theresa (1740–1780) in 1746 had a substantial impact on industrial development in Austria and the provinces including Hungary. The actual leader of the Directorium was the queen's husband, Francis of Lotharingia, who was good at business matters. To a certain extent, Hungary had a disadvantage as compared with Bohemia and Austria, because Hungary's role was to supply raw and basic materials for the different industries.

Act LXVII put into force by the national assembly of 1790 brought about some changes as it considered Hungarian handicraft and industry development important (HECKENAST (1991); MARCZALI (1885)). Mainly establishment of factories was encouraged implying some changes in customs administration. Subsequently it became obvious that guilds do not promote but hinder Hungarian industrial development (the bill proposal modifying guild regulation was passed on the 9th of June 1848).

What measures served industry development at the time? The first companies limited by shares appeared at the beginning of the 19th century (especially in metallurgy). The reason was that the (mostly) arms manufacturing factories needed more and more iron – produced in modern industrial procedures. As the tilting-mill owners did not have enough development capital, financial capital started to play a more and more important role in industrial development (for example, the Union of Murányvölgy was established in 1808, the Coalition of Rima in 1810). On the 18th of June 1838 a Trade Agreement was concluded between England and Austria: English capital was to establish export companies on the Austrian customs area mostly for trading in textiles and iron products (the Austrian customs area reached Russian borders at that time). Pál Almási Balogh, family doctor of Count István Széchenyi wrote in the 16 June 1839 issue of *Gazdasági Tudósító* (Business News): '*England would like to establish a customs-free warehouse for its products in Pest*.' Although the plan was not implemented, the England-Hungary Institute was established on the 16th of May 1841. Lajos Kossuth (1802–1894) welcomed the institute in his journal *Pesti Hírlap* (Pest News). Accordingly, he wrote the following on the 22nd of January 1843 in Pesti Hírlap: 'The Hungarian Trade Company does not want sacrifice but calculus from its shareholders... every Hungarian can be assumed to make profit from his/her money in a manner that enables the flourishing of the homeland... agriculture is the base for our wealth... without *industry* (my italics, J.N.) an agricultural economy is a giant with one arm... without trade neither agriculture nor industry shall flourish...'.

As we have seen, thinking about founding the Hungarian Trade Company started on the 22nd of January 1843 in Pesti Hírlap, its first meeting took place in Bratislava on the 3rd of July 1843. Among others, Pál Nemeskéri Kiss (governor of Fiume), Pál Teleki, Gábor Klauzál, Bertalan Szemere attended this meeting beside Count István Széchenyi. Ádám Vay was requested to preside. Subsequently the

Védegylet (Protection Society) was established, and its members declared: '*we oblige ourselves to buy Hungarian products in the coming 6 years whenever it is possible.*' As a result of Kossuth's organising works, 138 branch offices evolved in one year. The government made efforts to stop the society's activity, so Kossuth and his followers established the Factory Foundation Society in 1844. The new society seemed independent although it obviously had stems in the previous one. In line with its name, the new society supported factory foundation by issuing shares and providing credit to manufacturers who settled in Hungary.

Hungary's 19th century social and economic development was determined by three interrelated series of events: the reform age, the revolution and war of independence of 1848–49, and the Compromise of 1867. Struggle for the national language and culture accompanied with the establishment of large-scale industries comparable with Western development. The Hungarian industrial revolution was not a late copy of Western European industrial revolutions, but it evolved in unique conditions. Industry development of the 19th century did not only mean adoption of a new technical culture. It implied a new work culture, it changed the structure of employment and training, it gave rise to a new technical/skilled layer; and all this had helped development of Hungarian towns and villages. Fruits of industrial development started and accelerated in the reform age were harvested after the Compromise of 1867. These were milestones in the 19th and 20th century industrial development of Hungary – also related to the political and social history of the country – with different roles and possibilities of engineers. The focus is on the latter in the coming parts.

2. Impact of the Compromise of 1867 and the Government Policy on Industrial Development. Engineer and Creation

The Compromise of 1867 – which called the Austro-Hungarian Monarchy to life – had a substantive impact on the country's economic and industrial development. We think it is rightful to say that the age of dualism equals the age of modern industrialisation, rapid and spectacular development of large-scale machinery industries in Hungarian economic history (*Table 1*).

Table 1 shows that Hungary had a rapidly developing industry at that time. Between 1869 and 1910 the share of industry in employee total rose to 18.3% from 10%. In 1857 altogether 409616 people worked in industry, in 1869 this figure went up to 646946 and by 1890 it exceeded 913000. Certainly, the larger weight of handicraft was somewhat problematic in Hungarian industrial development. Károly Keleti, the famous statistician wrote in 1871: '*most branches of industry are still occupied by artisans*'. With the exception of milling and iron production, industrial procedures were dominated by handicraft, nonetheless, marked changes had taken place by 1913. By then, handicraft constituted only 23% of industry (Keleti (1871), (1873); Kövér (1982)).

By the end of the 19th century, iron and metal industry, manufacture of ma-

Table 1. Average annual growth rate of industry 1860–1913

Country	%
United Kingdom	1.2
France	1.8
Germany	2.9
Austria	3.1
Sweden	5.4
Italy	1.5
HUNGARY	3.5

chinery and transportation equipment were the most characteristic industries, from the turn of the century electric engineering and manufacture of precision equipment also developed. Coal mining also picked up as more energy was needed to these industries. Out of the mentioned branches, the manufacture of machinery was the most large-scale industry. The National Federation of Industrialists (GyOSz) wrote in its 1903 Annual Report: '*Hungarian iron production and manufacture of machinery is an earned pride of our country, which is known as it stands in the foreign competition with respect to quantity and especially to quality*'. Industrial development stimulated financial and capital markets, which hoped to realise an increased profit in the accelerated development pace.

Development of machinery production, its evolved and kept competitiveness naturally implied modernisation in the manufacture of basic materials including metallurgy (application of Bessemer and Siemens-Martin procedures). As it was mentioned, the manufacture of machinery was a large-scale industry in Hungary. Beside the Ganz Factory, which earned domestic and international recognition, the machinery factory of István Röck also started to gain importance: in 1853 the first threshing machine with manual and horsepower was fabricated, and from 1859 it was operating with steam as well (*A magyar*... (1921)). In the decades after the Compromise, steam boiler and other machinery were the main products (for the manufacture of silk, tobacco, etc.). The Schlick-Nicholson Machine, Wagon and Ship Industries Co. Ltd. was manufacturing iron constructions and boilers. The iron structures of the Opera's stage, the Main Customhouse (today a building of the Budapest University of Economic Sciences and Public Administration), roof of the Hungarian Academy of Sciences were manufactured there. The Láng Factory, the MÁVAG and the Arms and Machine Factory (founded in 1891) were gradually increasing their production (NÉMETH 1991).

Manufacture of vehicles was the most developed branch of engineering industry. Modernising transportation infrastructure, expanding railway network and the established river shipping provided a persistently growing market. MÁVAG started locomotive manufacturing in 1873. The 1000th locomotive displayed at the Millennium Exhibition in 1896 is a proof of boost. With the leadership of Zsigmond

Kordina, an internationally recognised locomotive designer team was working in MÁVAG at that time (Berlász (1959); Ganz, Németh (1996)). The locomotives manufactured here could run at the speed of 100 km/h in 1900. Recognition of locomotive manufacturing was well demonstrated at the Paris World Exhibition in 1900: MÁVAG's twin-cylinder express locomotive was awarded a Grand Prix. Shipbuilding was another important field of Hungary's steam engine industries and it also featured substantial production increase.

In the Óbuda-based factory of Duna Steamshipping Company (founded in 1836) 300 steamships and 700 barges were built between 1839 and 1895, in less than 60 years! The factory received many orders from abroad, so three additional shipbuilding factories were established on the Újpest bank of the Danube in the 1860s.

The invention announced by Donát Bánki (1859–1922; professor of the Technical University) and János Csonka (1852–1939; head of a training centre also at the Technical University) on the 11th of February 1893 revolutionised engine technology. The invention was the carburettor (the carburettor patent later submitted by Wilhelm Maybach, a German engineer, provided a higher level of prevention for the inventor because he patented it as a separate structural element). The merit of Bánki and Csonka cannot be questioned, however, their case draws our attention to patent problems of the age [8].

Beside transportation vehicles, manufacture of agricultural machines had a more and more important role in the second half of the 19th century. As it was mentioned before, the first threshing machine and steam locomobile was manufactured in István Röck's factory. A subsidiary of the Austrian Hoffherr-Schrantz company started production in Kispest at the turn of the century: this was the largest agricultural machine producer of the Monarchy. In the countryside, the Moson-based metalwork of Ede Kühne (who emigrated from Germany in the 1850s) developed into a significant agricultural machinery plant. Until the turn of the century, 20000 sowing machines were fabricated from the famous 'Hungária Drill' brand. This brand was a hit product at the Paris World Exhibition in 1900 (*Kühne*... (1939); Gelléri (1887)).

The last decades of the century brought us the evolution of electric power engineering, to the development of which Hungary could also add a few inventions and products. Although the German Friedrich Siemens obtained patent protection for the dynamo in 1866, the physicist Ányos Jedlik had credibly recognised the principle of dynamo in 1858, then he made his first dynamo and in 1861 placed it in the equipment store of the Pest university of sciences.

The first important application field of heavy-current engineering was electric lighting. However, electric power plants were not only for that purpose: they enabled 'feeding' of electric engines, which markedly influenced other fields of industry as well. An energy distribution system that is economic in long distance transmission was a precondition to industrial use of electric energy. The solution was delivered by three excellent engineers of the Ganz Factory: Ottó-Titusz Bláthy (1860–1931), Miksa Déri (1854–1938) and Károly Zipernowsky (1853–1942). As it is known, the transformer was their common invention, which was displayed at the Budapest Industrial Exhibition in 1885. The new system of electricity distribution revolutionised electric technology. The Ganz Factory started the serial production of the transformer immediately (ZIPERNOWSKY (1886)). Additionally, the Ganz Factory started to manufacture electric railway motors attaining a weight in another industrial branch. The famous constructor, Kálmán Kandó (1869–1931) was a mastermind in the development of railway motors [27].

Hungary's industrial development at the beginning of the 20th century was determined by the evolved internationally competitive large-scale industries of the preceding century. This implied not only an expansion of factories and new establishments, but also a sharp rise in industrial employment. Hungary started large-scale industrial development later than Western Europe. This lag, however, – despite the lack of domestic capital in the 20th century – meant the opportunity to adopt modern technologies that determined industry structure and development throughout. The internal economic community of the Monarchy could equalise the differences to some extent and it promoted the inflow of foreign capital from other countries as well. All these processes intensified the activities of large banks that supported and financed industry and partially contributed to restructuring of internal markets.

By different measures of support to industry, the government intended to achieve '*or at least substitute to some extent the industry development measure, which was otherwise used to shape sovereign customs affairs and existent for reasonable use of industry protection on customs area*' (Act III of 1907).

What were these measures? From the first Act on Industry (1881) – until the 1890, 1899 and 1907 acts – factories enjoyed 15 years of tax and fee allowance, reduced fares for transportation and customs allowance. To understand the impact, it should be mentioned that more than 1700 factories enjoyed these allowances between 1881 and 1913. There were new industry support measures from the turn of the century: financial subsidy and aid for machines were given to newly established or extended facilities and craftsmen. A total of 55 million crown state subsidy was given to almost 500 factories between 1899 and 1914. In turn, the factories obliged themselves to realise substantial fixed capital investments and employ 48 thousand new workers. In parallel, the government elaborated a 10-year industry development plan in 1907, which '*targets industrial independence of the country by the time economic self-reliance will have come when trade agreements expire*' (which was due in 1917). The plan aimed at the establishment of 284 new factories (121 factories were established until the breakout of the First World War).

Two factors must be taken into account when Hungarian industrial development and technical culture at the end of the 19th and beginning of the 20th century are discussed. First, leading people of Hungarian industry had been thoroughly studying technological achievements of the developed countries and tried to use them in the country. Second, they had continuously been making efforts to find markets for Hungarian products of the local technical culture. Modern engineering education was a helping hand in development. It was modern because the Technical University was not a citadel distributing knowledge but an institution serving the preparation for the engineering profession, employing professors with significant industrial experience, inventions and patents. Opinion of professors from the Technical University counted when industrial policy decisions were made. In the long run, the industry could acquire and keep markets if its modern and reliable products could stand the competition.

3. Industrial Policy and Technical Achievements between the World Wars

After the First World War, the collapse of the Austro-Hungarian Monarchy, Hungary faced new challenges. As a result of lost territories (the peace treaty concluded in Trianon), the economy became extremely distorted. Industrial capacities that manufactured railway equipment stayed in the country whereas only 38% of the railway network remained within Hungary. Trianon detached all the known hydrocarbon fields and all the salt mine capacities. Ore mining was reduced to the iron ore of Rudabánya and manganese ore of Úrkút. Coal mining dropped to its half as compared with the annual 10 million tons during the First World War (SELÉNYI (1954)).

While milling capacity was 6.5 million tons in 1920, the arable land yielded 2–2.8 million tons of grain. Thus, utilisation of mills hardly went beyond 30–35%. As far as metallurgy is concerned, 31% of the capacities remained within the new frontiers. Inflation was galloping: 100 Hungarian crowns equalled 11.6 Swiss francs in August 1919 as compared with 3.1 in June 1920.

In order to stabilise the country, Count István Bethlen (1874–1946), prime minister of Hungary requested 600 million gold crowns as credit from the League of Nations. The interest was 7.5%, and this sum was given so that Hungary had to repay the war damage compensation (amounting to 200 million gold crowns) from this credit in 20 years. In the second half of the 1920s Hungary was given new credits and soon it became the most indebted nation of South-Eastern Europe.

Nonetheless, the credit was very useful to restructure industry whereby some industrial branches started to develop once again, attaining international success. Industrial production rose by 70% in 1924–1927. Manufacture of textiles tripled until the imminent Second World War. There were several reasons behind: on the one hand, factory buildings were easy to acquire (dilapidated mills, arm production sites) and on the other, cheap labour force was also attractive to investors.

As a result of bauxite research, this new field of mining had also developed from the middle of the 1920s (in Gánt, bauxite exploitation started in 1926 and it has been continuing until today. That time the Gánt site was one of the largest bauxite fields in the world).

Natural gas research turned to success in 1935, mineral oil research in 1937. 2500 meters below the surface level carbon dioxide was found in the Mályi region, near Sopron. The Carbonic Acid Factory of Répcelak could come into existence. In Bádafapuszta (Zala County) high quality oil and gas broke to the surface; the works were led by the famous geologist Simon Papp (1886-1970) (PAPP (2000);

BEREND T. (1958)).

In the middle of the 1930s, the production of electric steel started to spread. In addition to the furnaces built in Diósgyőr and Ózd, the Csepel-based Weiss Manfréd Works started to gain importance in steel production. The manufactured basic materials from these factories contributed to the competitiveness of engineering and manufacture of vehicles. Restructuring of industry took years. Uneconomic production was shut down whereas some branches brought about international success (certainly, restructuring went along with the regrouping of labour force). The Hoffherr-Schrantz Factory started to manufacture tractors. Especially latifundia saw the start and acceleration of modernising agriculture (e.g. there were 1189 tractors in Hungary in 1920 whereas in 1929 there were more than 6800). Many Ford tractors arrived in Hungary (the Fordson brand); József Galamb (1881-1955) of Hungarian origin was their constructor. He was also the designer of the world-famous T-model, which won the Car of the Century Award in 1999 (TERPLÁN (1981)).

From the 1930s, MÁVAG was also able to manufacture reliable tractors. Threshing machines fabricated in Hungary were successful on world markets. Seed cleaning machines and the 'Zenit' hammer mills were sold in great number abroad.

The United Bulb and Electric Co. (Tungsram) had contributed to international recognition of Hungarian industry since its 1896 foundation. Following a short period of stagnation in the First World War, the factory gained new momentum. In formulating a successful business policy, the so-called market-oriented production, chief executive Lipót Aschner (1872-1952) played a very important role. The General Electric Co. set up the first industrial research laboratory of the world in the United States of America. A similar institution was established in the Váci road factory (Tungsram) in 1922 and it was the first of its kind in Hungary for a few decades. Ignác Pfeifer (1867-1941), professor emeritus of the Technical University, had been the leader of the research lab in Budapest for many years. Pfeifer had very good training before: he had worked with Professor Vince Wartha (1844-1914) at the Department of Chemical Technology, later Pfeifer became the head of department. After his early compulsory retirement he became a rich-in-idea researcher engineer at Tungsram and later he was appointed to be the head. In the middle of the 1920s, more and more modern electron tubes were developed to serve the rapidly spreading radios. In 1930 1.2 million electron tubes were manufactured in the factory and 75% went to export. Could the efficiency of tungsten lamp be improved? The answer was coming. The double-spiral lamp with re-coiled wolfram strip appeared at the end of the 1920s: it had 15% additional light power. In 1931 the factory's lab elaborated the so-called G.K. or macrocrystalline wolfram, which was needed for the modern electric bulb which is a still manufactured product at the turn of the 21st century.

In the meantime, on the 11th of August 1930, Imre Bródy (1891–1944), physicist of the factory lab announced a new patent: he invented the krypton-filled bulb and world success followed. Reliable and modern krypton-filled bulbs still have a substantial market all over the world. Their average lifetime is 8-10 thousand hours.

(The Genura-lamp is the latest product of the factory; its lifetime is fifteen times longer; see GÁSPÁR–JENEY (1990)). In the meantime Zoltán Bay (1900-1992), professor of the university of Szeged, was leading the lab.

As far as electric technology development between the two world wars is concerned, we should mention the start of radio broadcasting on the 1st of December 1925 and manufacture of radio that followed. Without going into details, but throwing spotlight on some tendencies, we should know that by the end of the 1920s there were 40–45 thousand radios fabricated in Hungary of which 70–75% was sold abroad.

With the help of the above few examples we wanted to grasp product structure, production trends and market policies of Hungary between the two world wars; with no intent to give a comprehensive picture. Having done so, now let's take a similar snapshot of the number and composition of the technical intelligentsia, which took the lead in implementing the above presented industrial development.

Hungarian economic development affected not only the profession breakdown and number of industrial skilled employees, but also that of engineers (BENE (1935); ILLYEFALVI (1931)). Number of the latter was 11409 in 1930, by 1941 it increased to 12480 (in 1941 there were 11733 doctors, 17178 teachers, 12710 pharmacists, 5553 agricultural skilled workers, 1410 veterinarians, 3281 economists and 7500 priests). 40% of the engineers was mechanical engineer, 27% general engineer (today: construction engineer), 12% architect, 8% chemical engineer, 6% other engineer (electric engineers graduated abroad), 3% forestry engineer, 2% mining engineer, 2% metallurgical engineer. In the 1937–38 academic year, 9.2% of university students attended the Technical University of Budapest. Unemployment did not leave the technical intelligentsia unscathed either (especially during and after the Great Depression). This time, i.e. from the second half of the 1920s till 1938 – the last of the so-called 'peace years' – 5–6% of engineers were unemployed according to statistics (mainly from the age group of the less than 30 years old). To ease the problems, ÁDOB (the National Committee of Unemployed Professionals) was established on the 3rd of February 1932. While we must not forget the difficulties of obtaining a job, we would stress that the employed professionals earned quite high salaries between the two world wars in Hungary. Average monthly wage of an industrial skilled worker was 146.4 pengős and engineers employed by the state earned 416 pengős on average (three times the salary of skilled workers). University professors took 894 pengős home (the multiplier is six as compared with skilled workers). College teachers earned 520 pengős per month. Thus, technical intelligentsia employed by higher education and industry received a substantial financial and social recognition.

During the Second World War, the structure of Hungarian industry changed due to state of emergency. War industry output rose, then as of Autumn 1944 disassembly of different factories and their relocation in the West had started in accordance with the government decree announced on the 25th of October 1944. The Central Government Commissariat for the Military Zone governed the operation. According to a survey compiled in 1946, equipment, installations, finished and semi-finished goods, basic materials were dragged from 415 factories. For instance, relocation of the Duna Aircraft Factory Co. started at the end of November 1944 and lasted until Budapest had been encircled by the fighting troops. 1800 workers and 600 clerks were relocated with 7–800 machines and basic material. From the point of view of war industry, aircraft factory of the Győr Wagon and Machine Industries Co. was also an important capacity [33]. The complete installation, all the employees and their families were relocated to Germany (legal successors started the search for relocated factories and factory-parts with the support of the Allied Supervisory Committee).

As it is well-known, Hungary had been bombarded continuously from 1944. Bombardments and land warfare operations caused serious damages in industrial buildings and installations. Certain industrial sites suffered 80–90% loss, and there were some factories that had been completely destroyed. Hungary was in ruins after the Second World War.

4. Industrial Reconstruction and Technical Development after the Second World War. Contradiction in Engineering Scales of Values

According to the Hungarian Economic Research Institute and GyOSz data, war damage of the national economy exceeded 21.95 billion pengős (at 1938 value). 2119 industrial factories – half of all installations – suffered an average of 45.7% damage in capacity. Damage of the manufacture of machinery was 750 million pengős. Transportation lost 3.7 billions of property, damage of buildings surmounted 4 billion pengős. Out of Budapest's 38130 buildings 2012 (5.3%) were bombarded to ruins, 6387 (16.8%) suffered serious, 24184 smaller damage and only 3456 (14.5%) remained untouched [1], [3].

As far as mining and metallurgy are concerned, mainly the technical installations were damaged, up to 50% of their value. Buildings and engines were damaged up to 33%, machinery up to more than 66% of its worth. Mines were flooded. The prime task after the war was to reopen the factories and restart production: one part went for reparation payments, the other for meeting domestic demand among the given circumstances.

Reparation payment obligations were enormous. According to the cease-fire agreement concluded on the 20th of January 1945 [37], Hungary had to pay 300 million dollars as reparation in six year (200 million to the Soviet Union, 70 million to Yugoslavia, 30 million to Czechoslovakia). The sums were understood at the 1938 exchange rate (1 dollar = 5.157 pengős) although the rate was 1:10.21 in 1945. By 1948, the exchange rate doubled again, so reparation payments multiplied by four at current prices. As a result of the changing political climate, the Soviet Union let the unpaid reparation go in the middle of 1948. Hungary altogether paid 131 million dollars according to the 1945 exchange rate. In line with the decision concluded at the Soviet-American-English summit (Summer 1945) and the post-war status of the country – because the armistice agreement of Moscow declares

'*Hungary's status is occupied country*' – German property situated in Hungary became Soviet property. Reopening the coal mines just as addressing employment difficulties was an utmost necessity to restart production. Many people were lost in war, others fled abroad and there were quite a few prisoners of war dragged to the Soviet Union. Work had started relatively quickly in factories producing for reparation.

Nature of reparation can be shown by a few examples from different factories (NÉMETH (1991)). At the Kőbánya site of the Metal Products, Arms and Machines Co.15000 dishes were fabricated for the Soviet Army between the 20th of February and the 1st of March 1945, then from March to May '*49452 kg enamel and 8788 aluminium dishes*'. In the same factory 70-1000 litre containers were manufactured for Soviet chemical production sites. Part of the metallurgical factory constructed in 1936 at the same site was relocated in the Soviet Union, together with 200 machine tools. In the factory situated in Soroksári street, 70 lathes and 1500 chandeliers were fabricated in May 1945, also for Soviet reparation. Since the 19th century, the Ganz Factory as well as MÁVAG played an important role in fabricating railway transportation vehicles for domestic and international markets. After the Second World War, these factories were engaged in manufacturing for reparation bounding almost all their capacities. The Soviet Red Army occupied the bombarded Ganz Factory on the 8th of January 1945. First, 'production' meant food containers, buckets, warming equipment, spades and hoes, which were changed for food. The military supervision lasted until 1945 (summer) also in this factory, then production for reparation started.

Beside other products, Ganz, MÁVAG and the Győr Wagon and Machine Industries Co. manufactured 4640 four-axed tank-wagons with bottom-dump doors and air brake and 800 four-axed tank-wagons for the Soviet Union until 1947. Yugoslavia received 10 four-axed third-class passenger coaches, 50 four-axed second class-passenger coaches and 50 mail coaches as part of the armistice agreement. 6 diesel motor trains (which consisted of three parts), 1000 two-axed wagons and 25 two-axed cooling-wagons were manufactured for Czechoslovakia. 10 motor trains, originally manufactured for Argentina but stayed in the factory due to war, were also taken by the Soviets as compensation [10]. 70% of the railway vehicles went abroad because of war, and half of the remaining locomotives was destroyed.

Shortage of basic materials also hampered restart of industrial production. Additionally, number of employees fell sharply as compared with pre-war figures, which was a serious problem as well. There were 35–40% fewer of the professionals with higher education degree against the peaceful years before war. By the end of 1945, following enormous efforts, only 23.4% of the factories did not start production. According to the general statistical survey of the recorded 4629 factories in 1946, almost all of the factories were working although not necessarily with full capacity.

One of the most urgent tasks was to restart transportation (especially railway) in order to ensure continuous raw material supply for the factories and product and passenger flow. Reconstruction of transportation – in line with military needs at the beginning – started with the help of Red Army sappers. Then the Red Army gave back supervision of the railways and skilled employees of MÁV (Hungarian State Railways) joined these works. By the end of 1946, almost half of the 28 exploded bridges of the Danube and Tisza rivers were rebuilt. Out of the destroyed 1400 bridges of the road 920 were reconstructed and out of the other 114 railway bridges almost 100 were finished.

Almost the whole country had to unify to launch reconstruction and production and the technical intelligentsia was also making efforts. The Free Trade Union of Hungarian Engineers and Technicians (MMTSzSz) was formed on the 18th of January 1945, and this organisation played an important role in activating the technical intelligentsia. It was not merely an interest-safeguarding organisation as its sections and sub-branches (both in the capital and the countryside) were discussing the most important tasks of reconstruction and members were active in implementation [27].

In parallel with the trade union activities Albert Szent-Györgyi, the Nobel-prize winner scientist took the lead in the movement entitled 'workers for science, scientists for workers'. In this framework, employees of MÁVAG, the Oetl Machine Factory and the WM factory had repaired university labs and other destroyed buildings in several hundred hours. For example, the MÁVAG workers worked 48000 hours on the reconstruction of the Péter Pázmány University of Sciences (today, in 2001, it is Loránd Eötvös University of Science). The Goldberger Textile Factory repaired the textile chemistry department of the József Nádor University of Technology and Economics (today it is the Budapest University of Technology and Economics). University professors gave lectures in factories. The lectures were then published in order to reach the widest possible audience.

Before the war – as mentioned before – there were about 10000 people with higher education degree in the domain of engineering sciences as compared with 5–6000 after the war (the reasons included being lost in war, captivity, fled abroad). MMTSzSz had a twofold task: to activate the technical intelligentsia for the purpose of accomplishing the difficult job of reconstruction and to improve the financial situation of this social stratum by means of interest-safeguarding. The latter was barely an easy task. In many factories there was resistance from the workers' part, often supported by left-wing parties. The technical intelligentsia was left out from the in-kind contributions introduced due to inflation or when the first stabilising collective worker agreements were concluded, the workers' trade unions refused the request of the engineers' trade union as to have a double wage for engineers compared with skilled workers. Nonetheless, – and the merit is that of the leaders of the engineering trade union, Béla Zentai (1914-1980), József Fischer (1901-1992) and others – in the collective agreements of autumn 1946, engineers were to have the double wage, which was higher than the wage of other white-collar professionals. Additionally, the so-called 'allowance for specific skill' was achieved, which was then extended to the professors of technical and natural sciences at the Technical University and other universities of science.

Hungarian technical intelligentsia was highly active in re-launching the country's economy: factories reopened, transportation was organised, bridges etc. were reconstructed with the help of engineers. Every section and regional body of the engineers' trade union reviewed the three-year plan on agenda (approved by the national assembly on the 1st of July 1947 – Act XVII of 1947) as to learn the problems to be solved in a given industrial branch or a specific region. When the post-war tension between workers and highly qualified professionals eased, skill and knowledge gained respect once again. The Free Trade Union of Hungarian Engineers and Technicians (MMTSzSz) wanted to strengthen (and not to weaken) this process. Unfortunately though, negative tendencies could be observed as early as the turn of 1947/48. Economic policy was confused and politics intervened more and more in professional affairs. There were also signs of distrust against certain groups of intellectuals.

On the meeting of trade union leaders as of the 20th and 21st of March 1948, István Kossa expressed his (otherwise groundless) criticism towards Béla Zentai and the engineers' trade union. By the time of the trade union's Second Congress (26–27 June 1948), the restructuring of engineers' trade union according to industrial branches went on agenda: in fact it meant the union's dissolution. Before the second congress, the Technical Intelligentsia Week (June 20–29, 1948) was organised: the rich programme summed up the activities so far and perhaps was a bit of demonstration against political intentions. Nevertheless, the engineers' trade union was sacrificed due to the more and more extreme political decisions of 1948. GyOSz went on the same track: this organisation (established in 1902) was also active in post-war reconstruction and dissolved in 1948 (re-established in 1991), almost in parallel with nationalisation of wholesale trade and large industrial companies. The Budapest Commodity and Stock Exchange had a similar temporary role after the Second World War: it was liquidated on the 31st of March 1948.

Contradictions of the 1950s were reflected in politics against the technical intelligentsia. This did not concern wages only, although the 1:2 ratio of 1948 (between skilled worker and engineer wage) shifted to 1:1.54 by the mid-1950s and to 1:1.14 by 1980. The share of unskilled leaders had grown and technical professionals were crowded out from decision making. Being qualified was no longer an advantage.

By the mid-1960s, it was more and more obvious that command economy did not imply progress, instead, setback of Hungarian economy took place: there was a time for more radical changes in economic policy as well.

Hungarian industry had a specific twofold nature before the change of the regime. A few products, behind which there was a substantial local and international experience and work culture, were selling better whereas there were many debt-making factories that produced medium and low quality products in huge amount.

Political changes of the 1990s carried and launched new economic processes that redefined engineering in accordance with the challenges of the 21st century and enabled a new industrial policy.

5. Conclusions

The article could not show the whole history of technical culture in Hungary, only three milestones were discussed: nevertheless, these have relevance today. Nations' history – and Hungary is no exception either – has turning points implying economic changes and industrial policy realigning, whose impact is hard to estimate at the given point of history.

Opportunities provided by the Compromise of 1867 were well used both in politics and economics. Industry showed substantial growth, new products appeared on market and Hungarian engineers were active in patenting: all these were accompanied by cutting-edge engineering education. Hungary emerged from the Eastern European region by its performance, moreover, many Hungarian products were of world-standard.

Historical literature is more and more rich and in-depth in showing the ages of development of 20th century in Hungary. Understanding industrial history is important and has important implications for today. The implemented industrial policy, redirecting of product manufacturing, acquisition, re-opening and keeping of local and international markets played a very important role in the reconstruction of Hungary after the two world wars. After the Second World War, national interest was unfortunately oppressed and Hungarian achievements of technical culture were eroded by a misunderstood industrial policy that did not focus on quality.

Apparently, all three milestones throw spotlight on the responsibilities, opportunities and constraints of government policy, which can either develop industry in the long run or steer it into a dead-end street.

Yesterdays also warn us: technical culture, engineers' responsibility and the opportunities can culminate in success only if the circumstances are given and yesterdays can encourage tomorrow's engineers so that there is a concept of supporters for the long run beside professional engagement. Yesterday events prove that research and development cannot be implemented in isolated blocks, instead, there is a need to co-operate, help and supplement each other.

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