ISSN: 2977-0041

Review Article

Journal of Material Sciences and Engineering Technology

Inventors – Industrial Engineers and Applied Scientists Before 1990 and After

Rolf Torstendahl

Uppsala University, Sweden

Corresponding author
Rolf Torstendahl, Uppsala University, Sweden.

Received: February 12, 2026; **Accepted:** February 19, 2026; **Published:** February 25, 2026

ABSTRACT
This article wants to point out a change in the conditions of engineers and applied scientists around 1990. Before 1990 engineers was a venerated group and those employed as engineers had strong organisations to back them up. After 1990 digital technology came into the limelight, and its master directors (without the title engineer) created a "new technocracy".

Keywords: IT-Oligarchs, Polytechnique, Machines, Inventors, Industrial Engineers

Conceptual Introduction

"Inventor" began to become a venerated concept through the industrial revolution. Earlier inventors had never got reputation nor riches. The first industrial inventors (in Britain in late 18th century and in Europe generally from around 1820) were considered to be engineers just because they could handle engines, at that time synonymous with steam engines and they created their own clubs and associations.[1] The continental idea of engineers was different, inspired both by the French word génie and the French educational institutes, the École des Ponts et chaussées and the École Polytechnique. The combined inspiration of the British industrial revolution and the French educational ideas, gave rise to a rapid growth of practical schools, soon called technical schools or institutes. There, young men were taught to experiment with chemical and physical products and to generalise about the results of these experiments. One may speak of professional engineers in the sense of employed technical experts with solid technical education from around 1850 on the Continent, but later in Britain, as the old associations there (which were named and called "institutions") became a hindrance for technical education of the continental type up to the end of the Second World War.

During the late half of the19th and the first half of the 20th centuries inventors in industry had their great time. Europe and the United States had approximately the same type of development up to the Second World War but. Here I will concentrate on the European engineers.[2]

The Importance of Engineering Education

One first remark has to be that there were several self-taught persons among those employed as engineers, even though self-taught is a misleading word. They had started in the workshops learning from and imitating those already in the craft, and finally the employer might give them the title of engineer. I would dare to say that applied scientists of today partially, in spite of their education, form a counterpart to these engineers. In the decades around 1900 the self-taught people gradually became fewer, especially after the slumps that rather regularly inflicted upon industry.

The graduated engineers from good schools or institutes of technology had an advantage. Their credentials from education were accompanied by a friendship that became common and even institutionalised among those who had graduated from the same institution. This created an important link that contributed to professionalism – strongest developed in France with separate associations for each school or each sort of school – and a

[1]This entire paragraph gives an abridged summary of chapter 2 in Rolf Torstendahl, Engineers in Western Europe: Ascent – and Decline? (1850-1990), Cham CH: Springer, 2021, where references may be found to the vast literature that it is founded on.

[2]For the US, I want to refer you to Tomas P. Hughes' book American Genesis. A Century of Invention and Technological Enthusiasm, New York: Viking Penguin, 1989.

Citation: Rolf Torstendahl. Inventors – Industrial Engineers and Applied Scientists Before 1990 and After. J Mat Sci Eng Technol. 2026. 4(1): 1-4.
DOI: doi.org/10.61440/JMSET.2026.v4.107

common education was a fundamental ingredient in the type of associations that made engineers form a European variety of professionalism. They often recruited young graduates from their own institute to the firm where they were employed, partly because they knew what these persons had to know and what they could be used for, partly also to have people in inferior positions who ought to feel gratitude to their older colleagues.

The Role of Inventions

Most engineers in industry before (and after) 1990 were (and still are) not inventors but administrators supervising existing technical systems. They improved machines and systems, when they saw a need for it, but they did not change more than they could judge as necessary to yield a profit compared to the replaced methods or machines. This is very important. The engineers were employed not to reform industry by inventions but to improve gradually on existing production methods.

I have no personal experience from work in special units for research in industry (laboratories or equivalent), but the impression from a few publicly debated cases and from conversations with people employed in such units is, that their liberty as researchers is far from total. When they have found out something new, a complex procedure had to take place. The invention not only had to be profitable in production compared to previously used materials and methods, but all changes in the marketing and use of the new article would have to be determined, to make it part of the industrial outfit. If a patent should be sought for the news, the employing firm and not the inventing person should be the owner, and the firm would be obliged only to give a minor part of the profit to the inventor, who could not have made the invention if he/she had not been an employee of the industry, supplying the laboratories and the materials used, when the invention took place. Companies want to be at the frontline of research, but their support of new knowledge is by no means unconditional. The economy of an industry is often stabilised by holding back news in the production line, which may turn out to be costly. This fact may be an important part of the explanation why there is a great difference between the inventors of the nineteenth century, who often had only their own laboratory and no big industrial investments to protect from radical news, and those of the 20th and 21st centuries, where many new inventions have been made by engineers or applied scientists without any possibility to create an industry of their own.

My conclusion is, that it will be very hard to vindicate that the industrial inventiveness of engineers and applied scientists today is lower or at least less creative than those of the late nineteenth century. Nor will I accept the contrary argument that statistics show many more patents nowadays than a hundred and fifty years ago. The number of employees used for research work, meant to yield patents, much exceed those of the late 19th and early 20th century. Inventions done now are less revolutionary, perhaps because there is less room for qualitative change in society now than it was, which is a thesis as difficult to vindicate as to refute. Thus, my standpoint is that it is impossible to make a comparison of what the individual engineers or applied scientists used for industrial research have contributed with.

All inventors are not engineers, and all engineers are not inventors. Probably the same can be said about applied scientists, even if my study of both these social groups is limited to those working in industry. For engineers the history of the 19th and 20th centuries is full of changes: professionalisation and specialisation were accompanied by educational changes ending in a pyramid topped by Technological Institutes. I have studied this process in detail, but not what followed after 1990.

The Role of Engineers

The massive entrance in industry of scientists who are not (graduated) engineers came after 1990 and is connected with the IT revolution. My own earlier investigations of engineers have been based in the first hand on registers of earlier alumni of technological institutes. For my long-term aims, I found only two TIs where the alumni had been rather regularly delivering some sort of report on their employer and the occupation that they held, the Eidgenössische Technische Hochschule in Zürich (ETH) and the École Centrale des Arts et Manufactures (later École Centrale de Paris), ECP. The ETH went over to digital registration of members in the 1980s, and the ECP in 2015 merged with the École Supérieure d'Électricité.[3] Thus, no detailed comparisons can be made for the periods before and after 1990.

Most of the graduated engineers from both mentioned TIs found their employment in the private sector, and there above all in middle-sized and big companies. However, there was also a constant stream of engineers into small enterprises, working either as consultants or as small industrial entrepreneurs, the latter much more often in France than in Switzerland. Those who were employed in industry had three main alternatives, namely, employed as works managers/foremen on the shop floor, or as designers in the drawing office, or as managers or management assistants in the administrative office. There were several levels of work both in the drawing office and in the administration, which in their turn might give a distinct status to some engineers working there.

To repeat, in the nineteenth and early twentieth century big industry often grew out of one person's invention or inventions. Many still existing industries from that time are named after inventors who were also owners alone or with some family members. These firms started with few engineers and many workers, but during the twentieth century their format changed in a way that can only be touched upon here. Ownership went from personal to share-holding, and leadership from personal to managers who were employed and represented the firm. This managerialism was based on economic considerations, as Alfred Chandler and several others have pointed out. With business economists the administrative centre got a new emphasis on rationalisation and profit-making.[4]

The 1920s showed that big industry, and the economy built on it, is no quite stable creation. The slump of a hundred years ago, affected the lives of many engineers. I know of two Swedish brothers who became engineers, one in the US and the other

[3]Torstendahl 2021, on the registers, see 305-307, on the problems of use, 131-142.

[4]A compressed overview is given in Torstendahl 2021, 11-16, where parts of the important discussion is cited.

(after Swedish schooling and a training period in the US) in Sweden. The emigrant brother was the inventor of certain chemical processes that appealed to the American Radiator Company where he made a rapid career. But alas, this was in 1927-28, and the ARC fell and he became without job, until his brother helped him to one in Sweden. There he did no longer feel at home, and remigrated with a last ship to the US, when passenger traffic was closed because of the Second World War. He never again became a leading guide in his field.

The younger brother had the good luck or good sense to get into the circle of engineers starting the Swedish Volvo firm. His career led him to being head of the design department and later he got the head post of heavy transport vehicles, which became important during the Second World War. When he retired owing to heart problems in the 1950s, he was a respected Chief Engineer, whose mark left in Volvo was hardly as a revolutionary inventor, but as a leader with an eye for which improvements were needed.[5]

This means that the inventor brother was vulnerable for economic shifts in a way that his brother, with his assimilating as well as forward-looking ability, was able to circumvent.

Engineers and Applied Scientists After 1990

Let me move to the period after 1990.[6] Then, another type of professionals, the master experts of the development of digital communication, have become a group that is partly competing with engineers in two ways: firstly, they have demonstrated how inventive they are in regard to making humankind dependent on digital means for communication both in leisure and in serious business; secondly, their elite members have placed themselves in command of huge businesses, where many engineers are their subordinates.

The most internationally well-known profiles in the digital sphere from 1960 to the present seem to be Bill Gates (b. 1955), Steve Jobs (b. 1955), Jeff Bezos (b. 1964) and Mark Zuckerberg (b. 1984). At present (2025-26) their fame is somewhat overshadowed by Elon Musk (b. 1971), whose field of activity has been much wider, encompassing car industry, space visits and rocket technology, and digital consumption software.[7]

There are several similarities that make these into a group. They seem to have been early interested in computers and their function (Gates, Jobs, Bezos, Zuckerberg), they did not bother to take a proper engineering graduation, and they directed their interest from the machines to the software. Their main interest was in networking through software (Gates, Bezos, Zuckerberg). Jobs and Musk have focussed on hardware, in Musk's case quite beside the digital sphere (rockets for space travelling, solar energy and cars) and he even gave himself the title of "Chief Engineer" for the Tesla car company. All five men had a passion for networking systems that made their business firms or their specific software a link between their customers.

These five persons form only the most successful part of the IT-oligarchy (I hesitate if Musk can be called an IT man), and there are lots of others who not only have earned money on their IT skills and sold their enterprises for huge sums (a great number of them are digital game producers) and these are often included in the so-called "new technocracy" (fundamentally different from the old one).

As another new group in industry, applied scientists have especially found employment if they were chemists, biologists or bio-chemists, that is, useful in areas not occupied by engineers. They have become a parallel to engineers in branches that have become more and more noticed for their relation to the climate problems. Sustainable development is in fact a new goal for social activities, and this is what the bio sciences focus on, which explains the many recruits from the bio-chemical sphere into industry. They brought with them a lot of established knowledge and innovations about the conditions necessary for a human existence on earth with respect for all other varieties of living creatures.

So far so good. However, we live in a period when several economists say, that present politics (which I don't want to elaborate here) is driving us to a new great slump. Then, I must remind you of the slump that brought about a great upheaval in 1928-1935 (duration shifted in different countries), and the story about the two brothers, both engineers, that I mentioned earlier. A slump does not afflict all economy and not all employees in the same way. In general, I would say, that inventors are more liable to be hit than the administrators in the case of engineers, when I talk about administrators in a wide sense.

Not only the ups and downs on the stock exchange are flexible and may change the labour market for all those who are employed in industry. Another important factor is the structure of the labour market itself. New occupations arise, and they may change the conditions for other groups. Managers with a Master of Business Administration in fact replaced engineers (not all but many) on the head functions in industry and they reconstituted industry in larger units and conglomerates. Applied scientists may also compete with engineers but in general terms they are on the same level. If a slump tests their stability, engineers have an advantage through their professional organisations with a rather firm foothold in society.

The five IT-oligarchs of today are taking the place of the most skilful engineers of around 100 years ago. They have their riches as an insurance, while the general engineers and applied scientists have no such personal assets for their protection. The applied scientists are not even protected by the solidarity of a common

[5]For further details on these two individual fates, see Torsten Torstendahl, En släktgren presenterad, 38-42, 46-47.

[6]The concluding part of this article is not founded on the kind of empirical studies of relevant sources as the preceding parts. For the time after 1990 I have used Google, Wikipedia, different newspapers and TV-programmes. For every single piece of information, it has been impossible to give an adequate source, but I have tried to make clear the general factual basis, and what I regard as decisive for the conclusions I make.

[7]What I say here and below about Bill Gates, Steve Jobs, Jeff Bezos, Mark Zuckerberg and Elon Musk is based on the interesting and many-sided biographies of these men presented in Wikipedia, Engl., accessed April 2025.

professionalism in terms of associations, active in protecting their interests in society with the help of the state. This was what engineers mobilised for in many European countries in the early nineteen-thirties. Thus, they reformed many of their professional organisations to a mixture of professional organisation and interest organisations or trade unions.

That such changes have been influential has become visible especially during the second presidency of Donald Trump. The DOGE group for diminishing state costs, was led by Elon Musk and (formally) Vivek Ramaswamy. The intensive activity of DOGE was exerted between January and May 2025, when lots of state employees lost their jobs. In May Musk left his post as head of DOGE, which continued to exist. Lots of public service suddenly ceased to exist, when state officials were fired. However, the saved amounts were much less than Musk had promised, and several services that were abolished had to be reinstalled.

The workforce of DOGE consisted mainly of Musk's collaborators in other projects of his, according to the few mentions I have found of this vital topic. Their methods seem also to have been contrary to what laws and previous agreements had stipulated. Musk, and also his mandator Trump, had earlier given voice to a disregard of legal limitations of the exercise of power, and this is an important part of the turning of the United States onto a road away from democracy to autocracy.

Unavoidably I have in the preceding phrases crossed the line between scholarship and politics. Let me return to the former. What happened in the first months of Donald Trump's second presidency has created deep going repercussions in most European societies. Keeping my eye only on the engineers and applied scientists in Europe, I feel quite sure (from occasional declarations and emotional articles) that they would not accept to be used by their employer – however rich – to destroy the public service through any mass firing of officials. This does not mean that I think that European engineers and applied scientists are more uncritical of some parts of State government and its administration than their US counterparts. Yet, they would feel that the same treatment might be used against themselves, and this would be scaring. In addition, in many countries in Europe even applied scientists have organisations that would take up their case and bring it to decision by court, and they would rely on the non-partial stance of the court or appeal to higher judgement.

To sum up, I want to emphasize that, when I analyse the development of politics in the US and Europe during the last two years, I see changes in both regions. However, the American one is more frightening from a democratic perspective than the European, and the democratic perspective is decisive for the future of employees of all sorts, including both engineers and applied scientists.