

**Creative inventors in Denmark and their impact in international business,
1895–1974**

Jørgen Burchardt jorgen.burchardt@mail.dk

Summary

Inventions have been the creations of highly diverse personalities. This paper analyse the inventors in the Danish patent system. When possible, each inventor was tracked in order to characterise he or her commercial fate and connection to different companies.

Many inventors have only one invention to their names, whereas a handful have been exceptionally productive. In developing the roadmap, special attention was paid to what drove the inventors, how wildly successful and less successful inventors differed in other ways, how catalytic innovators and their recipient business partners interacted and how the inventors and their customers interacted as well.

Keywords or phrases: inventor, patent, business, Denmark

Introduction

The introduction of new technologies depends upon the ability of individuals to understand and use new materials and tools in new ways. In today's industrialised era, ideas can be spread in scientific articles and books, and knowledge can be organised within international companies guarded by patents. Consequently, the speed of the acceptance of new technology in a geographic area depends upon a diverse set of preconditions.

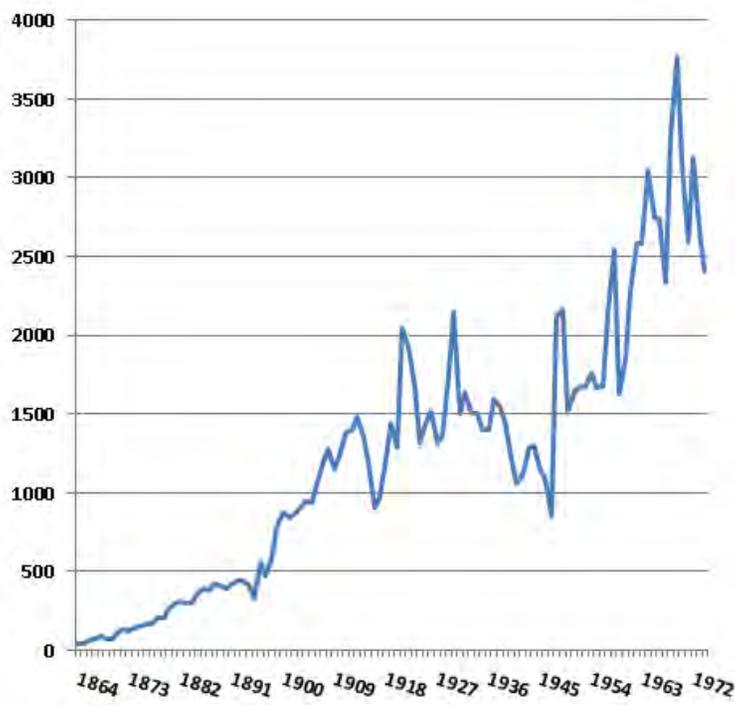


Figure 1 *Patents per year, Denmark.*

An excellent example of that dynamic has been the collective activity of the most prolific Danish inventors, whose patents were identified in databases and analysed for this paper. When possible, each of their inventions was tracked from its creation in order to characterise its commercial fate, geographical distribution and use at different companies.

On the whole, Danish inventions have been the creations of highly diverse personalities. Many Danish inventors have only one invention to their names, whereas a handful of them have been exceptionally productive. Of the most prolific, some have profited little, whereas others belong to a group of renowned, if not iconic, inventors who have amassed considerable wealth as a result of their work. Unsurprisingly, literature on that latter group of inventors is extensive. By contrast, sociological studies on Danish inventors in general have been few.

In response, this paper provides a roadmap of all sorts of Danish inventors and their varying degrees of success, especially in terms of patents. In developing the roadmap, special attention was paid to what drove the inventors, how wildly successful and less successful inventors differed in other ways, how catalytic innovators and their recipient business partners interacted and how the inventors and their customers interacted as well. Of course, acquiring qualitative answers to those questions is a time-consuming undertaking, and it was necessary to give priority to certain cases over others.

Time and place

The research conducted for this paper focused on Denmark from 1895 to 1974. The year 1895 was chosen to begin the period as the first year when efficient public administration for patents became established. Although patents had been granted in Denmark since 1651, an efficient platform for administering them was not established until 1895, following a law in 1894 enacted on the heels of the Paris Convention for the Protection of Industrial Property in 1883.

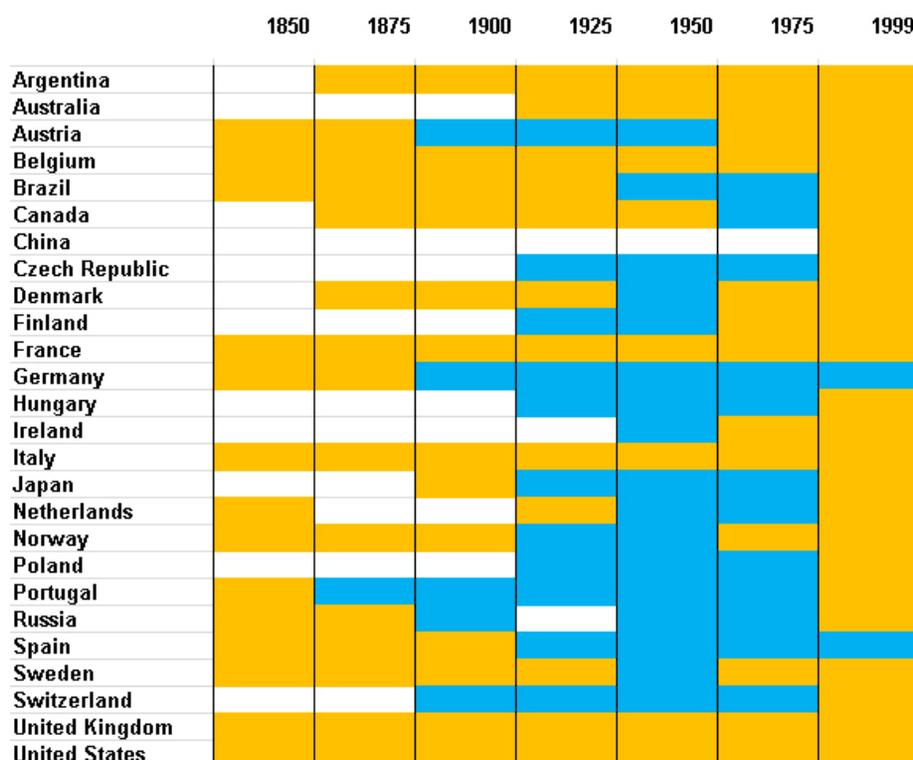


Figure 2 National patent systems. Example: chemical patents allowed (yellow) or not allowed (blue) (after Lerner, 2002).

Early on, each patent issued in Denmark protected an invention for 15 years from the date of issuance, though that period was later prolonged to 17 years. In other countries, the period of patent protection was longer and began upon the submission of the patent application. That latter condition was also later implemented in Denmark, where patent protection soon became extended from 17 to 20 years.

At the other end of the period, 1974 was chosen as the terminal year because patent administration from 1895 to 1974 in Denmark was rather homogeneous. Such homogeneity allows comparing the situations surrounding inventors over a substantially long period during which the framework for the registration of inventions was roughly uniform.

The chief source for the research was a database of the 127,299 patents issued in Denmark during the period. The database is derived primarily from the international database at Lens, with the support of additional information from Espacenet and the World International Property Organization. The material contained in the database is impressive, despite some significant weaknesses, as outlined in the appendix to this paper.

Today, international patent registration is rather homogeneous around the world. Before

1974, however, it was a complicated task to protect a patent across national borders. Each country had its own rules about what inventions could be registered and how, and allowances for patents on food, chemicals and plants varied from country to country and from era to era.

Denmark is a small country whose industrial output was rather strong during the period under study, especially in the more recent years. For the research presented here, Denmark's size facilitated a rather comprehensive overview of its inventions and their inventors during the period. It should also be considered that foreign inventors at the time tended to prefer to register patents in large industrial countries, whereas registering them in small countries became prioritised only more recently.

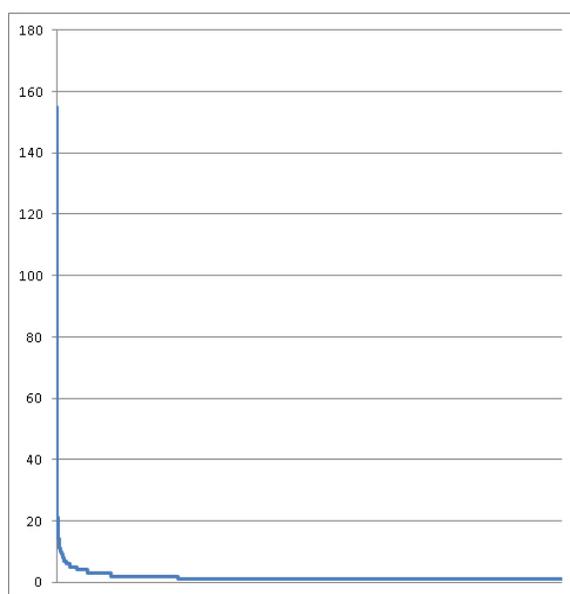


Figure 3 *Patents per inventor 1895-1974.*

The inventors

The analysis revealed that most inventors had registered only a single patent. Of the more than 50,000 inventors identified, 38,485 had only one patent, 6,796 had two, and 2,367 had three. Only 93 individuals had more than 20 patents, of whom only 27 had more than 30.

Some of the inventors with only one patent have been recognised by a project undertaken at Denmark's National Museum of Science and Technology. In the past, inventors could submit a physical example of their inventions to the patent administration for an appraisal of their functionality, and the collection of those submissions ended up at the National Museum. A closer look at those inventions reveals an array of hopeful inventors who believed that their ideas marked major progress for humankind.

For example, Niels Peder Richard Pedersen had attempted to patent a perpetual motion machine for years. Although he never succeeded in that endeavour, he did receive a patent for a guillotine for eel. That invention entered into production but achieved limited commercial success.

In a sense, Pedersen was lucky, because most inventions patented by innovators who ultimately obtained few patents never entered into production. The fortunate few also

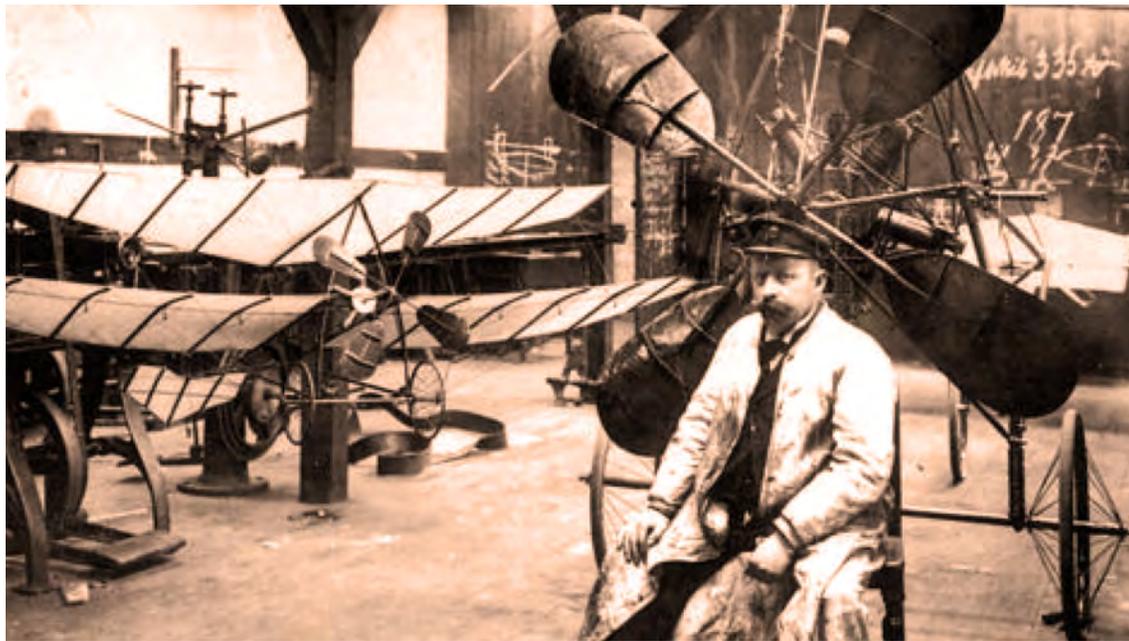


Figure 4 *Inventor Jacob Ellehammer at his important workshop in 1908. He won a price with his airplane (at left), when he at a contest in Hamburg as the only flew 50 meters.*

included Elise Sørensen, a nurse whose ostomy bag was inspired by patients—her sister included—who suffered from problems caused by ostomy. For Sørensen, the objective driving her innovation was to solve a specific problem, not to become an inventor. In any case, once Coloplast began producing the ostomy bag, the technology became a widespread success, and Coloplast became one of the world's leading companies in its part of the pharmaceutical industry.

In 2006, the Danish Patent and Trademark Office announced its list of the 12 most successful Danish inventions (Gunge, 2009 and Runge 2006). Although some were patented outside the period examined here, the Trademark Office included Peter Laurits Jensen's loudspeaker from 1915 on its list, even though Jensen lived in the United States and his invention was not patented in Denmark.

The list also includes a machine synchronising images with sound that, according the Trademark Office, should be attributed to engineers Axel Petersen and Arnold Poulsen, given their patent from 1923. By extension, Petersen and Poulsen's presentation of a film with sound in Copenhagen in October 1923 should be recognised as the first such event in history. However, their invention was only an improvement upon earlier inventions, including ones by Lee de Forest in the United States in 1919, and their presentation was not the first, which occurred in April 1923 in New York City (Gomery, 2005, p. 30, Eymann, 1997, p. 49).

Perhaps the most important Danish invention on the list was created by Valdemar Poulsen in 1899, who discovered how to preserve sound on a magnetic medium—namely, a thin wire—for a telephone answering machine. His ideas were later used to develop the tape recorder, the digital hard disk and many other useful tools. Among his other 33 patented inventions, Poulsen was awarded another central patent in 1902 for a generator that made radio broadcast possible.

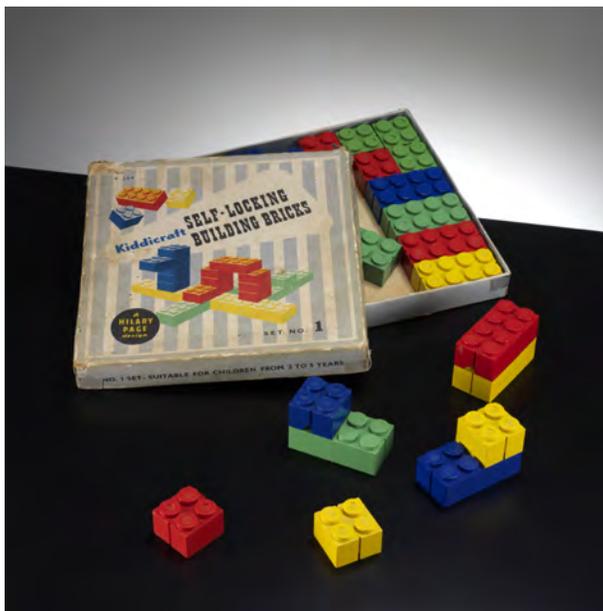


Figure 5 *The famous LEGO brick was an improved version of a British patent marketed as Kiddicraft bricks (picture: kawaii aichi).*

Of course, also on the list one of the most well-known Danish patents is that for LEGO building blocks. The application for a patent for the blocks was submitted in 1958 by Godtfred Kirk Christiansen, who ultimately earned five other patents as well. The blocks became the foundation for the LEGO toy company, which in time went international as the Christiansen family became the richest in Denmark. The lesser-known story, however, concerns the development of the company, which was formed as a carpentry business in 1895 and, in the 1930s, started making wooden toys. In 1947, company director Christiansen wanted to buy one of the recently invented plastic injection moulding machines, and the British supplier of that technology gave Christiansen samples of a Kiddicraft brick that Hilary Page had received a patent for in the United Kingdom in 1940. By 1949, LEGO had begun marketing a modified model of those bricks; because the Kiddicraft patent was exclusive to the United Kingdom, it was entirely legal to replicate and sell a similar version of the toys in Denmark (Jakobsen, 2017).

A weakness of the information in the database is the large share of inventions registered by companies without giving any attribution to particular inventors. Although that share was as low as 13% in 1895, it had increased to nearly 80% by 1967. Thereafter, administrative practice changed, and in few years, nearly all inventors were registered. At the same time, the share of patents made by several inventors grew to roughly 45%. Taken together, the trends suggest that many individuals behind patents at companies had collaborated to solve problems towards meeting the objectives of their firms.

However, the policy of patent attribution has continued to differ from company to company. IG Farben, for instance, has never indicated its inventors, whereas the German company Bayer has awarded inventors in its ranks 92% of the patents that it has received. One such inventor at Bayer was Gerhard Schrader, who between 1958 and 1968 earned 72 patents, more than any other non-Dane from 1895 to 1974. Among his inventions, Schrader developed parathion and other potent poisons and became suspected of having invented poison gas during World War II (Ruthenberg, 2007). In the post-war period, he continued to receive patents for technology within his narrow field of chemical expertise. Among the top 10 registered inventors were two other Germans: one from BASF and weapons designer Paul Mauser.

The seven native Danish inventors included on the Trademark Office's list were all rather active. For example, Torkild Valdemar Hemmingsen earned 48 patents within the design of diesel engines for large maritime vessels. Moreover, his company, B&W, the largest Danish shipyard at the time and leading company in terms of ship engine construction, has 33 inventions registered in the UK patent system (Pedersen, 1999, p. 351). Another engineer at B&W on the list was Ove Petersen, who also received 48 patents, as well as 53 foreign patents. As is emphasised all of BW's most productive inventors worked as chief engineers or directors at the company, in which roles they were best positioned to develop their ideas with help of numerous assistants and large staffs (Pedersen, 1999, p. 215).

Topping the list is Hans Christian Hansen, who was awarded a whopping 85 patents between 1938 and 1966, particularly in the field of advanced parts for gramophones. Ranked second is Anders Andersen Pindstofte, who earned 73 patents in his role at his company, Pindtoftes Maskinfabrik, from 1895 to 1925. All of Pindstofte's inventions concerned his company's specific task of bottle cleaning, a service used foremost by large Danish breweries.

Søren Wistoft was a similar inventor who also had his own firm, Søren Wistoft & Co. His 69 patents awarded from 1896 to 1955 were mostly for weights that the company produced. Erik Christian Bayer was another businessman with his own firm. His 62 patented inventions were developed from 1913 to 1955 mostly within the field of building materials, although he his other inventions included a cat's eye reflector for bicycles – a well-known tool in Denmark.

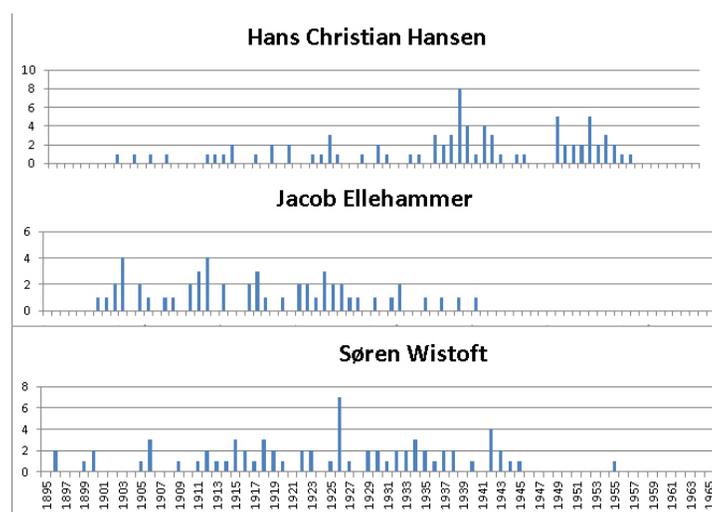


Figure 6. *Lifetime illustration of patents per year. Many inventors had a steady production over the years, as those three inventors with many patents shows.*

The last inventor on the list was of a type very close to the ultimate inventor. Born in 1871, Jacob Christian Hansen-Ellehammer, mostly known as Jacob Ellehammer, devised inventions for cars, motorcycles, airplanes and helicopters when those technologies were in their infancy. Ellehammer created the first air-cooled radial engine for motorcycles, and in 1906, he attempted to be the first to fly in an airplane that he had developed. Six years later, he succeeded in flying a helicopter that he had also created. Ellehammer's laboratory was expensive to run, however, and his businesses afforded no surplus until

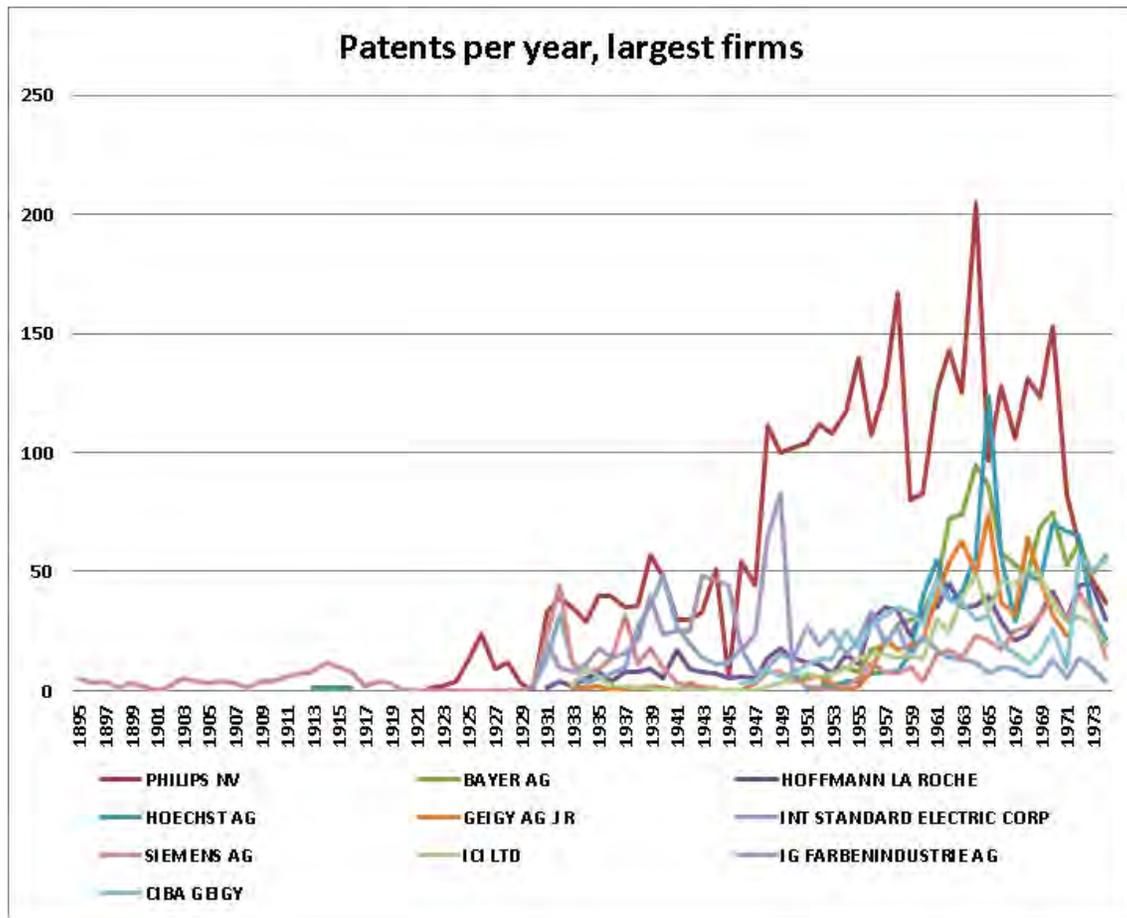


Figure 7. *The large international companies had an increased number of patents since the 1930s. Philips from Nederland was number one in patents through many years.*

he invented a pump for fire extinguishers (Skyggebjerg, 2014). All told, 57 inventions from 1901 to 1946 are attributed to Ellehammer, along with two patents of addition. As an example of his creativity, one of Ellehammer's inventions provided protection against an infamous killer known for suffocating his victims. Ellehammer's solution was a metal neck collar that would have prevented suffocation. Although the neck collar was not patented, it marks a case of a solution on the edge of absurdity.

A review of the top Danish inventors from the perspective of their lifetimes reveals a similar trend in productivity. On average, those inventors received one patent almost every year, and some had years with a particularly large number of patents with eight patents as a maximum. The two foreign inventors – late and from the pharmaceutical business – have a more intense activity with 15 patents each in their most productive years.

Overall picture

The Danish patent system grew steadily over the years examined in this paper. A few years after 1895, the annual number of patents exceeded 500, and the first thousand had been issued by 1906. Only a slight decline in patents occurred in 1916 and 1917 during World War I. Similarly stunted growth characterised the World War II era, although more than a thousand patents were issued in those years. Many of those patents from the United

States, the United Kingdom and other countries without connection to German-occupied Denmark were issued, apparently as part of a backlog of innovations from before the war. By the late 1960s, the growth in patents had reached an average of 3,000 per year.

Most registered inventions—59,541—during the period examined were made by Danish inventors (registered with a Danish priority number). Nearby countries registered large quantities of inventions as well (after they had got their national priority number), including the second-ranked Germany with 20,129 patents, the United Kingdom with 8879 and Sweden with 7613. In fact, most of the inventions came from Europe, whose count is bolstered by creations from Switzerland and the Netherlands as well as the other mentioned countries. Also in the mix is the United States, ranked third on the list with 11,490 inventions, and the upcoming Japan with 538 mainly in the 1970s.

The development of patent administration over time demonstrated strong internationalisation until 1974. As mentioned, the total number of patents increased, although the number of Danish patents declined from its peak in 1913 (i.e. 1479 patents) to the decade

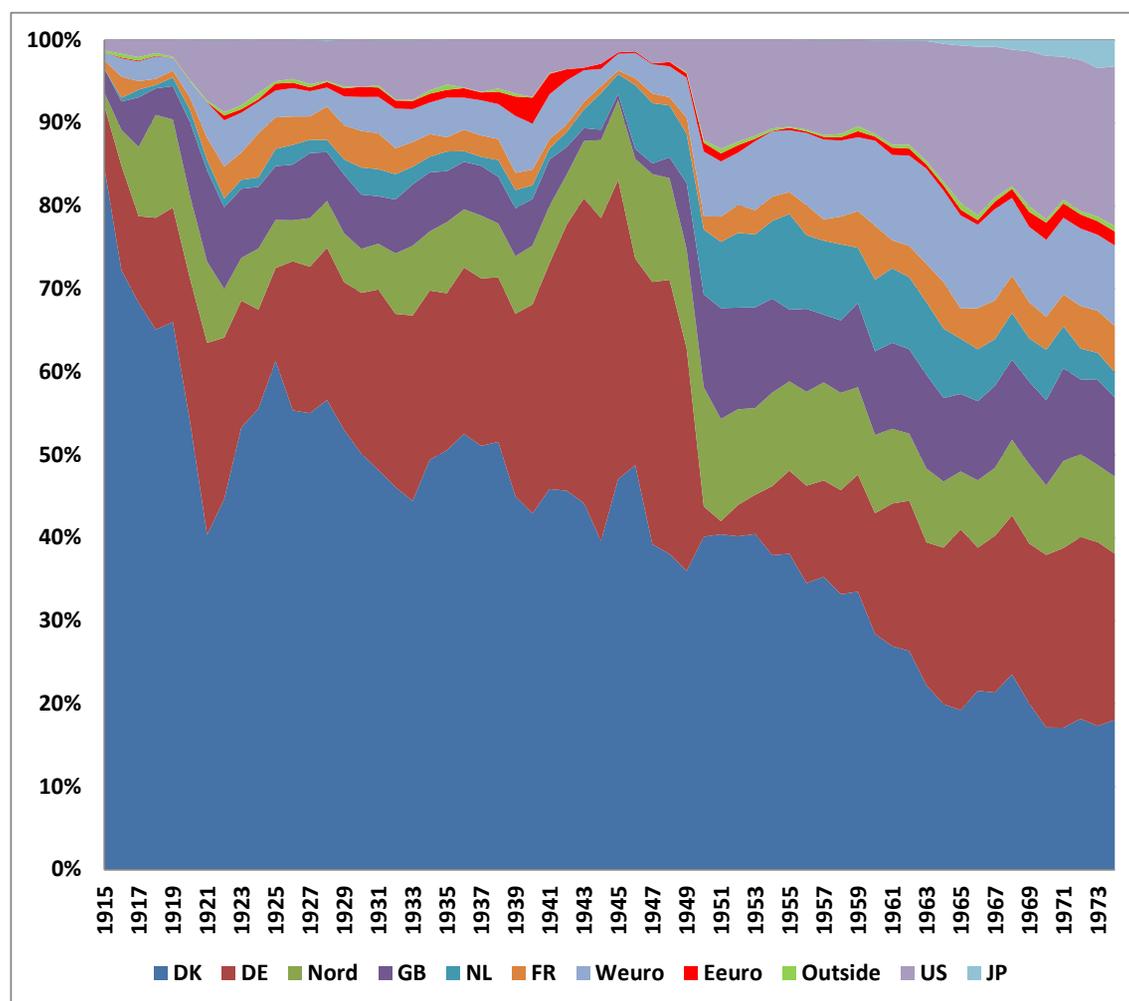


Figure 8. Patents issued in Denmark after priority country. The Danish inventors dominated relatively in the first years, but in the last periode inventors from Germany and USA had relative more. Nordic and other European patents dominated, but more patents from abroad, including Japan, increased in the 1970s.

after 1964 (i.e. 437–772 patents). In fact, German inventors had more patents than Danish registered in that decade, and inventors from the United States had more than it during the last nine years of the period.

Around 55,000 patents were issued to companies or associations. Three electronics companies appeared amongst the top 10 firms in terms of patents received, including the top-ranked Philips from the Netherlands, which earned 3,730 patents, foremost in the years after World War II. By contrast, International Standard Electric Corp. was strong in the years before the war, and Siemens received many patents both then and after the war.

Nearly all pharmaceutical and chemical businesses registered considerable quantities of patents after World War II. With 1051 patents, the German company Bayer was the second-ranked company in the top 10, while the British company Imperial Chemical Industries (ICI) ranked number eight, with 659 patents. Amongst pharmaceutical companies, the Swiss firm Hoffmann la Roche led with 856 patents, followed close behind by the German firm Hoechst with 848 patents. The Swiss chemical and pharmaceutical company CIBA had 708 patents and Geigy, followed with 653 patents (they were merged in 1970).

No Danish companies were among the most industrious, however. In 38th place, the top-ranked Danish firm was Danfoss, whose production of for instance thermostats involved 174 inventions. Ranked in 41st place was F.L. Smidth & Co, which received 161 patents for machinery in the cement industry, followed by the pharmaceutical company Leo in 50th place with 136 patents. Amongst the next 50 companies were only six Danish ones.

Conclusion

The overall development of international patent administration from 1895 to 1974 demonstrated two important trends. One is professionalisation, by which ‘glad amateurs’ were reduced in number on behalf of more dedicated inventors. The increasingly more complex management of patent applications increasingly required more funding, which had the effect of excluding a large number of potential inventors.

The other trend was internationalisation, in which the global market came to be conceived as needing protection for patents in as many countries as possible. The resultant patent system in Denmark awarded a larger share of patents to foreign inventors, and very few of them were independent inventors, whereas company-employed technicians dominated. Such employees often collaborated, and sometimes they engaged in systematic product development on large teams. As a result, the share of educated people from universities increased thanks to the inventiveness of self-made individuals.

Although providing a general profile of Danish inventors during the period remains difficult, all had personalities deeply rooted in a desire to find solutions to problems, and all worked on the edge of the unknown supported by their lively imaginations. A possible difference between their personalities could be their varying ability to judge the commercial viability of their ideas. With the help of an affiliated organisation—for example, a company—inventors could obtain sustained support from others and host ongoing dialogues about the potential for their ideas to be materialised and sold. Moreover, the tasks of building experimental designs and developing and performing tests could be best executed in the streamlined organisation of a commercial firm.

Appendix

Although the material in the database is extensive, it is also highly fragmentary and, for that reason, is best used with critical assessments. As a case in point, the names of inventors registered are sometimes inconsistent, and the same individual is liable to appear in the material under different names. For example, the great inventor Jacob Christian Hansen Ellehammer appears under six names:

- 1) Hansen-Ellehammer Jacob Christian, 38 times;
- 2) Ellehammer Hansen, one time;
- 3) Hansen-Ellehammer af Motorer M, 12 times;
- 4) Hansen Ellehammer, two times;
- 5) Hansen Jacob Christian, two times; and
- 6) Fabrikant af motorer og motork, two times.

Altogether, the database includes 57 inventions by Ellehammer. However, a detailed study of Ellehammer's company reveals that it received 59 Danish patents (Skyggebjerg, 2014, p. 34). In the database, two inventions seem to be missing, which by itself makes the uncertainty of the database about 4%.

The top Danish scorer during the period studied was Hans Christian Hansen, who in the database initially appears to have 85 inventions patented. A closer look, however, reveals that he is also listed once under the name Rask Hans Christian Hansen and another time as Hans Peter Christian Hansen.

Only further analysis can clarify whether duplicate names have helped to misrepresent the picture painted by statistics. Some names are so common that mentioning them is more likely than not. For instance, Christian Hansen, whose invented a gasket for a ship's bow in 1895, is clearly not another Christian Hansen, who 96 years later in 1991 invented a liquid manure spreader. However, the statistical processing of the database counts 'Christian Hansen' as only one person.

References

- Eyman, S. 1997. *The speed of sound: Hollywood and the talkie revolution, 1926-1930*. Simon & Schuster, New York, NY.
- Gomery, D. 2005. *The coming of sound: A history*. Routledge, New York, NY.
- Gunge, U. 2009. Her er Danmarks mest geniale opfindelser. Berlingske, November 19. Accessed digital edition accessed August 08, 2019.
- Jakobsen, S. 2017. *Lego-guld: Historien om Danmarks rigeste familie*. Gyldendal Business, København.
- Lerner, J. 2002. 150 years of patent protection. *American Economic Review*, Vol. 92, issue 2, 221-225.
- Pedersen, J. 1999. *Teknologisk udvikling i maskinindustrien: Burmeister & Wain 1875-1939*. Polyteknisk Forlag, København.

Runge, M. 2006. Kanon kårer bedste danske opfindelser. Jyllands-Posten, March 16. Accessed digital edition accessed August 08, 2019.

Ruthenberg, K. 2007. Schrader, Paul Gerhard Heinrich. In: Neue Deutsche Biographie, 508.

Skyggebjerg, L. K. 2014. Teknologihistorie: Historieforskning og -formidling i feltet mellem opfindelsesfascination og diskussioner om materiel agens.. Aalborg University Press, Aalborg.