Version final 30 March 2012

Presenting the (economic) value of patents nominated for the European Inventor Award 2012

Inventor file Jan Topholm
1. The invention

1.1 Historic account

Jan Topholm and Soren Westermann from Denmark revolutionised the hearing aid industry with the invention of the CAMISHA production process for the creation of tailor-made hearing devices. Their firm, WIDEX, patented technology has been out-licensed to all major hearing aid manufacturers and ear mould labs.

Hearing aids were the subjects of inventions already in early times, such as in the 17th century with the metal ear, in the 19th century with ear trumpets or the first electronic hearing aid constructed after Graham’s Bells telephone in the late 19th century. In the early to middle 20th century, particular advances were made with transistor-based hearing aids.¹

WIDEX A/S is a family-owned firm specialised in hearing aids. Christian Topholm, an engineer, and Erik Westermann, an entrepreneur, set up the company in 1956. The company’s first hearing device, the Widex 561, became available in the same year.

In the 1970s and 1980s, a particular type of hearing aid devices, in-the-ear hearing aids (ITEs), became popular. These devices fit in the outer ear bowl, the concha. ITEs are tailor-made to fit each individual’s ear. They can be used in mild to moderate hearing losses.

WIDEX produced such hearing aids, too. However, as Jan Topholm recounts

“...the process to manufacture such aids was very cumbersome then. You first had to create one or more impressions of the ear of a patient. You then had to work on that impression to create a mould. This step involved removing excess material from the impression, repairing small flaws in the impression and immersing the impression in a wax or similar fluid to smooth the surface. The mould, made up of a material such as plaster or a type of gel, would then be based on this impression. Into this mould, one would need to pour in a liquid, synthetic resin. For individually fitted hearing in-the-ear hearing aids, once (part of) the liquid hardened, one had to take excess liquid away. The mould would be destroyed to obtain a cast, but this cast would again be subject to several processing steps before one could get an actually usable shell.”

Jan Topholm and co-inventor Soren Westermann, the descendants of the company founders, were not satisfied with this labour-intensive and rather imprecise production method that was utilised for the production of large number of hearing aids. In 1990, they came up with a number of different ways to improve precision and efficiency and filed for respective patent protection. The patented solution(s) envisaged using, for example, 3d laser scanning for creating ear impressions, computer modelling of these impressions or stereo lithography² to produce the shells.

However, it turned out that considerable work was still needed to turn the invention into a production process which would work under real-life conditions:


² “Stereolithography (SLA), also known as optical fabrication, photo-solidification, solid free-form fabrication and solid imaging, is an additive manufacturing 3D printing technology used for producing models, prototypes, patterns, and production parts.... Stereolithography is an additive manufacturing process which employs a vat of liquid ultraviolet curable photopolymer “resin” and an ultraviolet laser to build parts' layers one at a time.” (taken from Wikipedia, [http://en.wikipedia.org/wiki/Stereolithography](http://en.wikipedia.org/wiki/Stereolithography))
“Stereo lithography became commercially available only in the mid-1990s. We used this technology, however, more or less off the shelf afterwards. Furthermore, we needed to develop and tweak the software that would create the ear impressions from the laser scan and model the shell. We wanted the software to not only create a model that would perfectly fit into the ear. We also wanted it to model the positions of the various technical components of the hearing aid device within the shell in order to minimise the space occupied by these components. Eventually, it took us ten years from the time we applied for the patent until we had a truly applicable running solution.” (Jan Topholm)

In order to create the software, WIDEX collaborated with an external small software firm, 3shape. WIDEX also invested in the then-start up firm located in Copenhagen, and WIDEX was the first customer of the firm. 3shape “...later transited its expertise into other areas that needed 3D techniques and digitalized workflows. Today 3Shape is a world leader providing digital solutions for dental, orthodontics, hearing instruments, footwear, and quality control applications.”

Back to the hearing aid devices, the novel production process has been used in actual production since 2000. Widex started to license the technology to its competitors, often through crosslicensing agreements, thereby ensuring Widex’ license (and hence access) to one of the competitors patents. The process was named CAMISHA (Computer-Aided Manufacturing of Individual Shells for Hearing Aids). The name CAMISHA was also registered as a trademark. Interestingly, and according to Jan Topholm, the CAMISHA process implements only some of the aspects that have been patented in 1990.

Jan Topholm estimates that virtually all hearing aid manufacturers and ear shell labs today use the CAMISHA process. There have been some (patented) enhancements to the technology, covering special variations, but the basic and mostly applied process has stayed the same. CAMISHA has been also adapted for the production of behind-the-ear hearing devices, for the part of the device that extends into the ear (ear-mould or dome): “For behind-the-ear hearing devices, CAMISHA’s cost savings are not that pronounced as with in-the-ear hearing devices, but it is still a much more elegant way of production.” (Jan Topholm)

Since CAMISHA, the company has still introduced numerous innovations, including: the world’s first fully digital in-the-ear hearing aid (1995; CNN listed modern, digital hearing aids as one of the top 25 innovations of the past 25 years); the world’s first hearing aid designed specifically for babies (2010) or the world’s first receiver-in-the-ear (RITE) super power hearing aid (2011).

1.2 Technological features
The CAMISHA process can be described in the following steps:4

- “The ear impression is scanned using a three dimensional scanner. With digital photography, a laser as the light source, and computer-aided design, a 3D virtual image of the ear impression is generated.
- The virtual images that are created can be modelled into the hearing aid through the use of state-of-the-art software utilizing high definition colour monitors and powerful computers.
- The modelling technicians can make changes to the virtual image that has been generated. Here, the length of the canal portion of the shell is optimally adjusted to prepare for the electronics.

3 http://www.3shape.com/about-3shape/3shape-history.aspx
4 http://en.cel.opentopia.com/term/Widex , slightly adapted by Jan Topholm
• The technician further examines the virtual shell and determines if material should be added or taken away. The colour coding shows exactly how much is added or removed.
• The CAMISHA software not only designs the shell, but also designs the entire hearing instrument. Here the components are evaluated to ensure that they fit correctly into the shell.
• With the CAMISHA system, the venting is precisely and consistently designed into the shell while providing exactly the space needed for the electronics.
• One of the final steps is to check that all the hearing aid components fit precisely into the shell. The CAMISHA process produces a hearing aid that will fit well and is cosmetically appealing.
• This state-of-the-art equipment utilizes laser technology to accurately build the shells. Each shell produced contains its own identification number during the manufacturing process.
• The last step is to cure the shells in an ultra violet (UV) oven. This ensures a resilient plastic shell that will precisely fit the shape of the user’s ear.”

2. The market

The Western European hearing aids market is forecast to grow at a compound annual growth rate (CAGR) of 4.8% from 2010 to 2017, according to a recent market report by Frost & Sullivan.5 Globally, the market for hearing aids was worth some US$ 6.6 billion in 2010.6 The global growth rate is said to be even larger (+ 6% p.a.).

Growth forecasts by the market research firm are larger than historic growth figures:

“For years, yearly growth has been at around 4% p.a., which means that it is a rather slow growing market. On the positive side, one has to say that it is rather insensitive to economic crisis and that it has still a lot of growth potential. We estimate the current penetration at 10% to 20%, depending on the country. In countries such as Denmark, Australia or the UK the penetration rate is already 40%.” (Jan Topholm)

According to Jan Topholm, there are as many as 10 million hearing aid devices produced globally each year. Given that the average lifetime of a hearing aid is around five years, and that many users have two devices, the estimates are that there may be some 25 to 50 million users of hearing aids globally.

Factors driving demand are an aging population – there are estimates there will be around 700 million people with moderate/severe hearing loss by 2015 compared with 300 million in 2011 – and technological innovation. Bluetooth technology has had some spectacular impact already, with the Frost & Sullivan Report stating that “...every manufacturer has some form of wireless product or product line.”7 Other growth drivers are the segments of cochlear implants and bone anchored hearing implants.

The industry is split among half a dozen major firms, and WIDEX is one of these top-6 manufacturers globally, the other major players being Oticon, Siemens, Sonova

---


Holding AG, Starkey Laboratories Inc. and GN Re-Sound. These six manufacturers account for 90% of the market.

The CAMISHA process is still the basis of nearly every in-canal hearing aids in the world, and the technology is also licensed to other hearing aid manufacturers. WIDEX has 32 subsidiaries in different countries around the world, and representations in more than 100 countries. In 2011, the firm had around 3,000 employees worldwide, 1,000 of which are stationed in the headquarter country Denmark. The export rate amounts to around 97%, and yearly turnover is in the order of €400 million.

3. The role of patents and Intellectual Property Rights (IPR)

3.1 Motives and benefits of patenting and employed IPR strategy

For WIDEX A/S, patents are a very important part of the business strategy. Each year, the company tries to apply for some patents. The main rationales are:

- Patents are used as a bargaining chip, a means of trade, between the main companies active in the hearing aid sector. The patent guarantees hence some ‘freedom to operate’ for the firm in the patented technologies, and it provides a venue to obtain access to patented technologies of the competitors. “Like in real trade, you need to be on the same eye level as your partner,” explains Jan Topholm, “if we would not have patents, we would rather quickly find ourselves in a corner where we cannot move any more on the market.” As hearing aids make use of different complementary technologies, it is necessary for the firm to ensure access to this technology.

- WIDEX also patents inventions to protect its right to produce and sell products incorporating these. Otherwise there is a risk that a similar invention is patented and used to hinder our production.

WIDEX uses the patents only defensively, and when out-licensing, is pricing the license at low levels in recognition of the fact that each hearing aid includes a larger number of (patented) features. The firm does not want to start a tradition of high-price licensing in the industry, as this would likely jeopardize the functioning ‘patent trade’ and inhibit mutual access to technologies. Notwithstanding the defensive IPR strategy, the firm underlines that it would pursue litigation and enforce its IP, should there be a need, as a matter of principle.

With regard to geographical coverage, WIDEX A/S patents selectively, i.e. seeks for patent protection where there is either a big market or a competitor. Patenting is done as early on as possible, to avoid that someone else is faster and patents the invention(s) itself. Besides patents, WIDEX also uses trademarks and, to a lesser extent, registered designs and utility models. Utility models are appreciated for mechanical designs, where the firm sometimes seeks for low cost, fast and simple IP protection.

Concerning the CAMISHA process, the firm underlined that the process would be very open, and no trade secrets (i.e., commercially valuable information kept secret) used. The licensing of the CAMISHA process, while priced at low levels, has accrued income of two digit millions euro order. The monetary value of the CAMISHA patent can be equated to the licensing income, minus the costs of the patent which has been in the order of €100,000, according to Soren Westermann.

Soren Westermann is in charge of patents and IP at WIDEX. WIDEX has a dedicated patent department that employs three European patent attorneys, three engineers and two administrative staff. The patent department is already early involved in the R&D.

---

Presenting the (economic) value of patents nominated for the European Inventor Award 2012

process, so that appropriate IP action can be taken. However, there is no written strategy.

Soren Westermann gauges that

“...patenting is an important thing and has to be done professionally. It is very difficult, expensive but must be addressed.”

3.2 Patent statistics and patenting trends

The patent behind the nominated invention (EPO516808) with application date (priority) of Dec 21, 1990, was eventually awarded by the EPO in 1996. Patent protection has been extended to 12 European countries (Austria, Switzerland, Germany, Denmark, Greece, Italy, Liechtenstein, the Netherlands and Sweden). Furthermore, the firm applied for a patent also in Japan, the U.S. and Canada. After more than 20 years, the patent lifetime is now expired.

Jan Topholm and Sören Westermann have applied, up till now, for 36 patent families. Under the firm name Topholm & Westermann (today WIDEX), the firm applied for its first patent in 1964. Since then, the firm has continuously increased its patenting activities. Since 2000, there have been on average 14 patent applications per year (priority applications). All applications have created a portfolio of 195 patent families. 146 of these have been applied for at the world level. The firm extended also the geographical coverage of patent protection with time – it now patents also in Australia, Japan, China (since 2004) and Korea and Singapore (since 2011).

Besides patents, WIDEX protects also the design of the products through registered designs (there is evidence of 33 such registered designs in the databases).

A measure of patent quality is the number of times a patent has been cited by other patents as prior art. The nominated patent has been cited 78 times, especially by the firms Phonak, Siemens and Cirtes. Others have, to date, cited 857 times WIDEX patents. The nominated patent is the one that is the most cited among the WIDEX patents. The citation statistics thus point to a high quality patent.

In-the-ear hearing aids are the subject of many patents. Since 1980, there have been more than 2,300 patents applied for in this subject field. Yearly application figures have increased to more than 150 patent applications p.a. European applicants did most applications, which may be indicative of European technology leadership in this field. The most active applicants are Siemens (272 patent applications) and Phonak (CH, 142 patent applications). Danish firm OTICON ranks third with 108 applications and WIDEX ranks forth.

4. Conclusions

The patented technology is of high value, as it created the standard for the manufacture of tailormade in-canal hearing devices. The value is also exemplified in the two-digit € million licensing revenue obtained, but extends far further (e.g., in terms of WIDEX own sales).

The following were main success factors, as seen by Jan Topholm:

- Early application for patent protection, in order to avoid that others have the idea first

9 Search strategy: 1 H04R-025 (Deaf-aid sets) + in-ear
• Spending considerable time on elaborating many solutions to the problem (i.e., thorough elaboration of the problem)