TEKNOLOGISK INSTITUT

Danish Sound Cluster

Megatrends in the Sound Industry

Opportunities for Danish Sound Companies

The report was prepared by the Danish Technological Institute in collaboration with Danish Sound Cluster

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Emil Højbjerre Thomsen
Annemarie Holsbo
Arne Hørlück

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> **The megatrends offer both opportunities and challenges for the sound industry**

Foreword

The Danish sound industry is undergoing significant changes driven by technological advancements and evolving consumer expectations. Denmark, with its strong heritage in sound technology, is well-positioned to take advantage of these developments.

This report examines key emerging trends that stakeholders believe will impact the industry in the coming years, such as artificial intelligence, immersive audio, biomonitors in audio devices, and new Bluetooth standards along with consumer trends and business models. These trends offer both opportunities and challenges for companies within the sector.

Adapting to these changes is essential for maintaining a competitive edge. Companies need to innovate and align their offers with consumer demands and today's global and digital competitive situation. This report provides strategic guidance to help Danish sound technology companies navigate these trends, encouraging collaboration and adaptation to stay competitive in an evolving market.

The report outlines possible avenues for focusing innovative capabilities in the coming years for our members, and it serves as a compass for both start-ups and established companies in setting the course towards the future.

We greatly appreciate the contributions from the many industry stakeholders, who provided their expertise and perspectives for this study. Together, we can ensure that Denmark continues to excel in the global sound technology industry.

Torben Vilsgaard
CEO, Danish Sound Cluster
+45 2926 0000
tv@danishsoundcluster.dk

Executive summary

The Danish sound industry has a long and strong tradition. Emerging trends are set to significantly impact the industry and its markets in the coming years, and Denmark is well-positioned to benefit from the developments. This report spotlights the most critical megatrends for the Danish audio industry, covering technological advancements, consumer demands, and evolving business models.

In terms of technological trends, Denmark mirrors the global surge in innovation within audio technology. The Danish sound industry has seen a 77 % increase in the number of audio-related patents over the past 5 years with Danish hearing aid companies leading the way. Artificial intelligence stands out as a key area of innovation, with significant growth in AI and audio-related technology patents.

Danish audio-tech companies are well-equipped to explore AI, and many are currently on par with global leaders in the application of the technology in their specific domains. Provided that Danish companies prioritise working with specialised chipsets, high-quality data, and the necessary competencies, the potential for innovation is big.

Additionally, stakeholders from the industry anticipate that bio monitors, immersive audio, and new Bluetooth standards will impact the industry, supported by rising innovation activities in these areas.

Consumer demands should guide the strategic investments in innovation. Industry stakeholders especially emphasise the importance of convenience, sustainability, and heightened awareness of the impact of sound on health. The rising awareness of noise pollution holds great potential for building upon the existing Danish expertise in acoustic solutions.

The business landscape is evolving with new competitors adopting direct-to-consumer models and circular business practices like product-as-a-service. Both offer opportunities for Danish sound enterprises. Furthermore, adapting to big tech ecosystems, which are highly appealing to consumers, can open additional possibilities. Collaboration, or "coopetition," among companies can foster innovation and competitiveness in an industry increasingly dominated by big tech ecosystems.

By leveraging the emerging trends, Danish companies have a unique opportunity to lead in global audio technology innovation, driving forward-thinking solutions that align with market demands and consumer expectations

Chapter 1

Introduction

The sound technology landscape is evolving rapidly, driven by technological advances – e.g. artificial intelligence, Bluetooth, and immersive audio, along with changes in consumer behavior and expectations. These trends are unlocking new market opportunities while also posing potential threats to established business models.

As a leading hotspot for sound tech development, Denmark is well-positioned to capitalise on these developments. However, success is not guaranteed.

This report provides insights for Danish sound technology companies on key emergent trends and technologies that are foreseen to impact the industry in the years to come. Throughout the report, we provide relevant insights into the trends that have potential to impact the industry in terms of relevant consumer shifts and new business models. Most importantly, it outlines possible areas where innovation may be strategically relevant for Danish sound enterprises in the coming years.

The analysis holds relevant insights for all relevant business domains that are represented by the Danish Sound Cluster (as illustrated in figure 1).

In the following subsections, we cover some of the most important trends in the industry. Firstly, we cover technological trends, followed by trends in consumer behavior and expectations, and lastly, we focus on how new business models are set to affect the markets in the years to come.

Figure 1. Categorisation of the Danish sound industry

Health & Hearing

Treatment of hearing loss and propagation og hearing aid

Prevention and remedy of hearing damage

Sound and music therapy for general well-bein g and treatment of somatic and psychiatric disorders

Ultrasound, scanning and diagnosis

Sound technology in defense

Acoustics & Environment

Acoustics at home & at work

Acoustics and Architecture – new design principles

Acoustic properties of building materials, furniture and decorations

Vibration and noise measurements

Sustainable environments – sound design in urban areas

Noise reduction from wind turbines, metro, roads, industry

Audio Experiences

Hi-fi at home, in cinemas – 3D sound

Sound experiences at concerts, art installations, theatres, museums

Sound quality and speech enhancement for phone calls, emergency services, video meetings, computer games

Voice control in "Smart homes" and robotics

New musical instruments, sound design tools

Source: Danish Sound Cluster

Not all trends are equally relevant for all parts of the industry, although the trends that are covered have been chosen based on the scope and extent of their relevance.

As an initial step of the project, a series of workshops was held, gathering nearly 40 representatives from companies of all sizes and academic scholars associated with the Danish sound industry. During the workshops, the representatives gave their take on the most important trends to watch and their perspectives on the expected impacts.

Looking across the trends discussed during the workshops, the most frequently mentioned trends within technology development, consumer behavior and business models were selected. These trends are the ones that are further elaborated in this report and deemed as megatrends for the sound industry.

Chapter 2

Technological megatrends

Technological innovation is an important driver for changes in all industries, including the sound industry. New technologies and advancements in well-established technologies can bring about new business opportunities but also pose a threat to established companies. In the following subsections, we take a deep dive into the general innovation trends in audio technology, followed by technological advancements in particular technology areas and their potential impact on the sound industry. The technologies covered are artificial intelligence (including chipsets and synthetic data), immersive audio, biomonitors, and Bluetooth.

Innovation in audio-related technology: Denmark's position in a global context

Denmark has a long and strong tradition as a technological powerhouse within the field of sound – being at the forefront of developing innovative and cutting-edge solutions in speakers, headsets, hearing aids, and acoustics solutions. This section delves into the dynamics of technological innovation related to audio technology and compares Denmark's performance with global trends through the lens of patent activities.

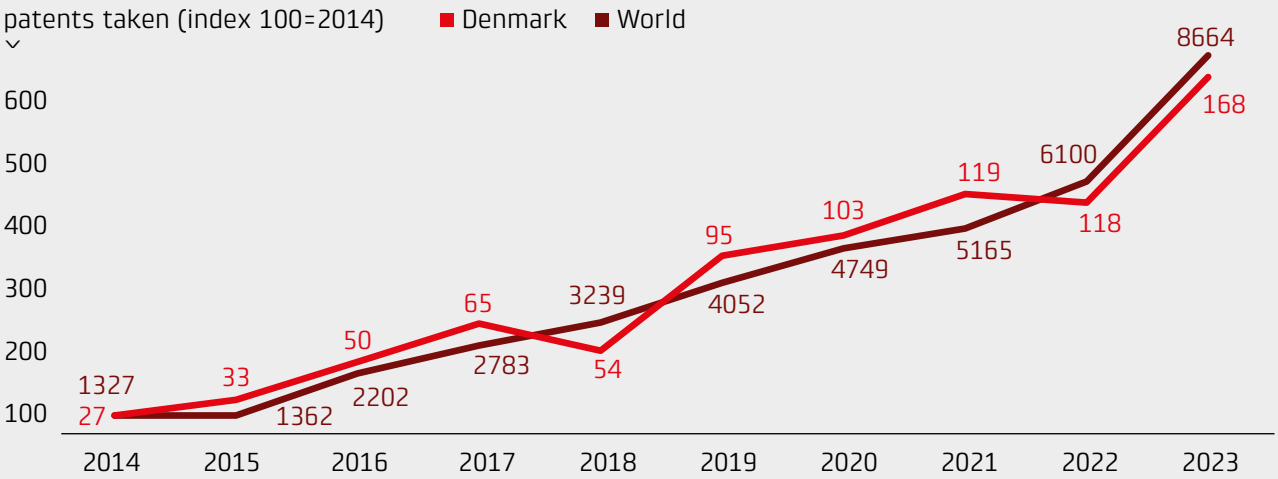
Patents are often utilised as a proxy to evaluate innovation activity. While not a flawless measure – since they do not capture non-patented innovation[1] – they nevertheless give insights into substantial and valuable technological advancements.

Looking at the patent activity for audio-related technology over the past decade, the number of global patents has significantly increased, with a notable surge in the last few years. This trend shows a global momentum toward innovation in sound technologies. This can both reflect that patents have become a more integrated part of the industry and be taken as an expression that audio-related technology is gaining more focus and has become a technological field of increased interest.

To compare the absolute development in patented innovation in Denmark and the world, figure 2 depicts the indexed development in the number yearly granted patents. Reflecting the global upward trend (though obviously with a smaller absolute number of patents) over the past 10 years, Denmark has seen a sharp increase in patent applications from 2022 to 2023. This signals Denmark's role as a frontrunner in audio technology innovation.

A closer examination of the entities holding these patents reveals that the industry is heavily influenced by a few large corporations, particularly from the consumer electronics sector. Globally, Samsung leads in the absolute number of active patents. Moreover, when focusing on patents estimated to be valued over USD 500,000, Samsung also ranks at the top, indicating high potential commercial value.[2] Specifically, Samsung has been a leader in developing patented innovations in areas such as immersive audio technologies and advanced noise-canceling features.

Figure 2. Trend lines for audio-related innovation in Denmark and the world



Note: Index over the evolution in the number of approved and active audio-related patents. The numbers in the graph show the absolute yearly numbers of new patents. 2014 = Index 100. Source: Danish Technological Institute based on data from PatSnap

Other leading companies across the audio-related technology field are Japanese manufacturer Murata, and consumer electronics enterprises Sony, TDK, and Panasonic.

In a Danish context, the patented innovation is predominantly in the realm of hearing aids. The three large companies – GN, Oticon, and Widex – not only lead in the quantity of patents but also in the quality, as evidenced by their significant presence in the segment of patents valued above USD 500,000. This is not surprising given their substantial market share in the global market for hearing aids.

To further dissect the innovation landscape for audio-related technology, we have looked at the most frequent focus areas for the patented innovation.[3] Globally, the category "Selective Content Distribution" leads in patents, indicating a strong interest in technology used in the process of delivering specific audio content to users based on their preferences or location. For instance, algorithms used to analyse what you might like to listen to, based on your previous choices or the preferences of others like you.

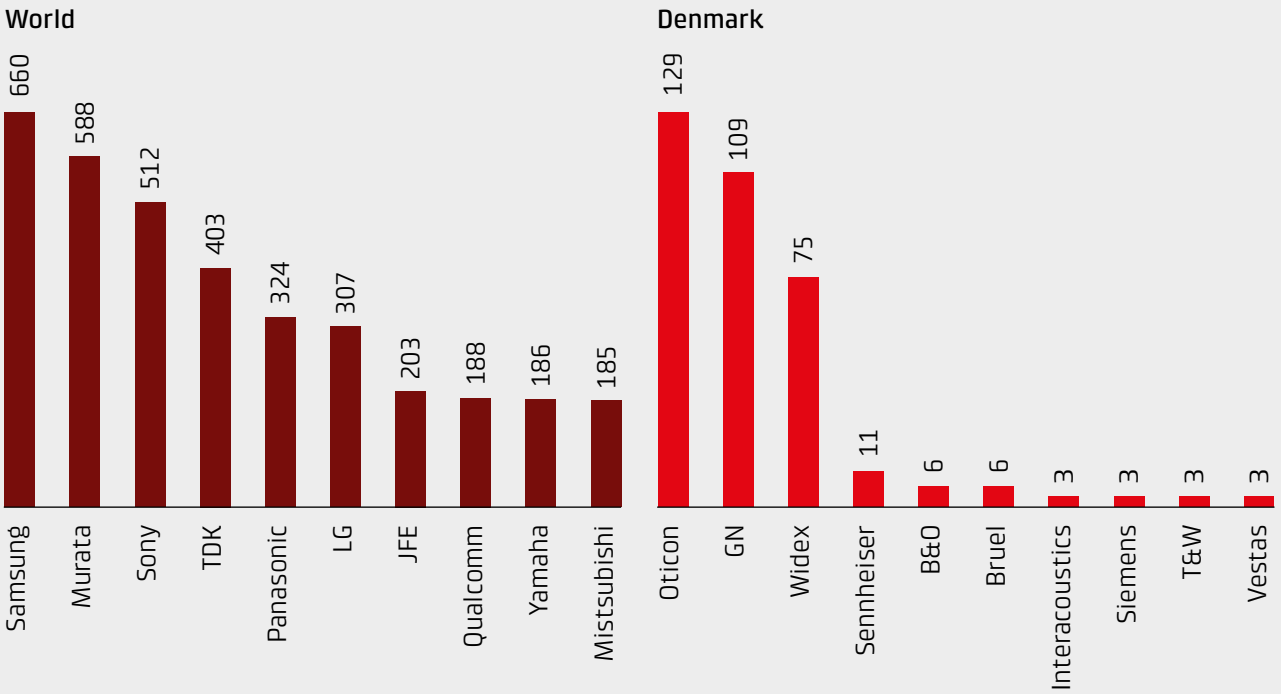
This area is followed closely by "Electrical Transformer Components" (components that help manage the flow of electrical energy to audio devices) and the more self-explanatory areas of "Loudspeakers" and "Microphones." These domains are broad and relevant in many subfields of the audio industry, but at the same time, they highlight the areas where there is a large general focus globally.

In Denmark, the focus is slightly different with the top three technological areas all related directly to the hearing aid sector, while also encompassing many other categories relevant to the sector. This specialisation reflects Denmark's historical strength and market leadership in this segment, and it also indicates the current interest of the hearing aid industry.

In conclusion, the analysis not only underlines Denmark's alignment with global innovation trends, but it also highlights its unique focus on hearing aid technologies and other subfields. Interestingly, the analysis also shows that audio-related technology is a rapidly evolving area on the global stage, and Denmark seems to maintain a strong position within this industry, emphasising the role of the Danish audio industry in the broader Danish business structure. In particular, Denmark excels in innovations related to hearing aids.

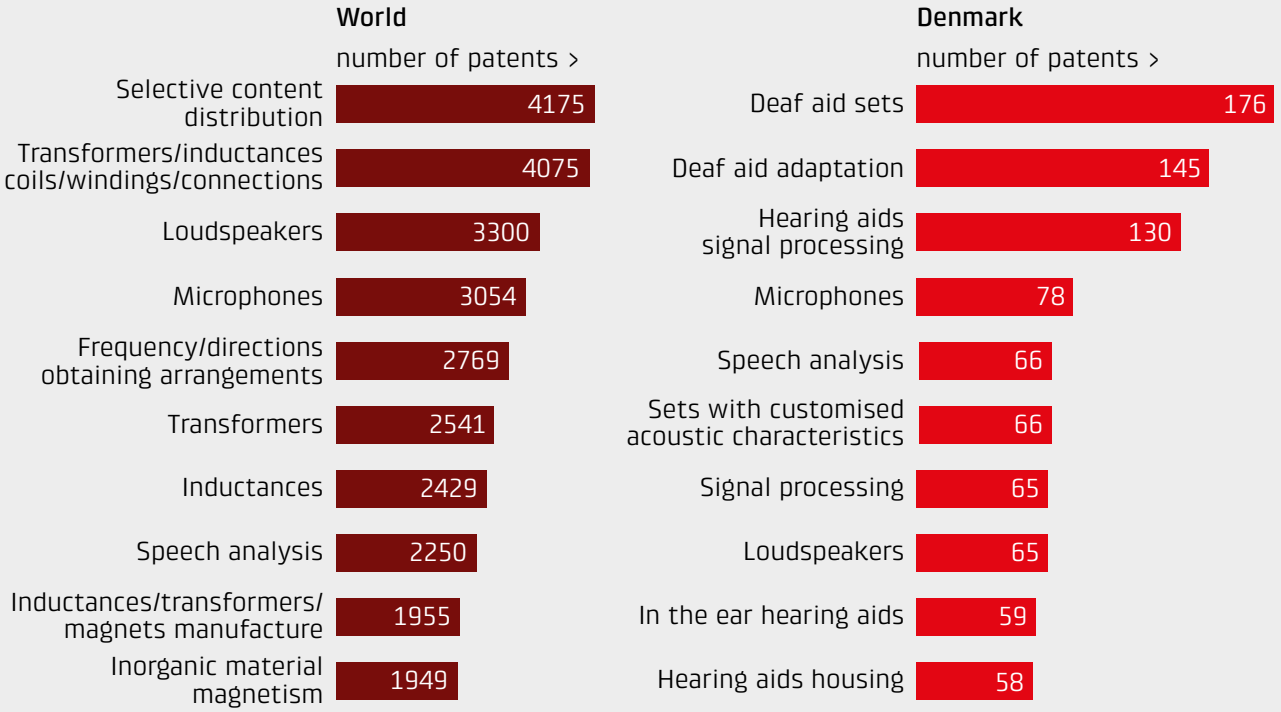
The data indicates that Denmark has a favorable position as a leading nation within technological innovation in audio-related technology, providing a strong foundation in the years to come. As some of the following subsections will show, Denmark has leading patenting companies within some of the audio-related subfields that will likely influence the future.

Figure 3. Ranking of the companies holding the largest number of high-value patents



Note: ranking of the companies holding the most patents with an estimated value above 500,000 USD, both in Denmark and globally. Source: Danish Technological Institute based on data from PatSnap

Figure 4. Most frequent application domains for AI-related technological innovation in Denmark and the world



Note: Ranking of the most frequent "application areas" of audio-related patents. Application areas are based on IPC and CPC-codes, but automatically generated by PatSnap. Source: Danish Technological Institute based on data from PatSnap

Artificial intelligence: a potential transformation of the industry is on the rise

Across all industries, artificial intelligence (AI) is high on the agenda, and the innovative potential with AI technology is huge. That goes for all types of innovation (product, process, marketing and organisational innovation).[4] While marketing innovation and organisational innovation, and to some extent process innovation, based on AI technology are likely to be comparable across business sectors, AI offers distinct opportunities to the sound industry in terms of product innovation.

From incorporating new AI-driven product features like personal assistants in your headset that can make suggestions and guide you through the day, to simulations of acoustics in planned buildings, and automatic recognition and adjustment to the present surroundings of the headset.

AI is a promising new technology that will likely be influential in the coming years. Denmark boasts a few leading companies in this field, as well as a range of startups and smaller companies actively working with AI technology. However, there are some preconditions worth considering to fully harness the potential of the technology, along with new barriers to be aware of.

The AI game is also a game for the big tech companies. Developing and training AI-algorithms is a complex, time-consuming, and costly affair that requires data, hardware and competencies. This means that traditional audio companies are likely to experience increased competition from industry giants within consumer electronics like Apple, Google, and Samsung. Thus, many other companies who want to work strategically with AI ought to take this into consideration.

Danish producers are already at the forefront of incorporating AI in products, particularly in hearing aids and headsets. For example, GN has launched a hearing aid that integrates AI technology, and both Jabra and EPOS leverage AI in their products and when developing new products. While Danish companies do not develop the fundamental AI technology – which primarily takes place in the large tech companies like Apple, Amazon, Google, Microsoft, and others – they excel in applying AI to products. This positions several leading Danish companies in the audio sector at the cutting edge of AI application. Additionally, this expertise holds collaborative potential for other Danish companies and provides an opportunity to learn from local peers.

Tehcnological innovation in AI technology related to the audio industry

The interest in AI has surged over the last few years. This is also reflected by the increase in the yearly number of new patents related to AI. To examine the AI-related innovation in the audio indus-try, we have analysed patents that lie in the intersection of AI and audio-related technology.[5]

The upward-going trend illustrated by the index in figure 5 is obvious. It shows a steep curve, indicating that audio-related AI technology is an important technological trend to watch in the coming years. In comparison, casting a glance at the trend for patented AI technology in general, it seems that the curve is even steeper for audio-related AI technology.[6]

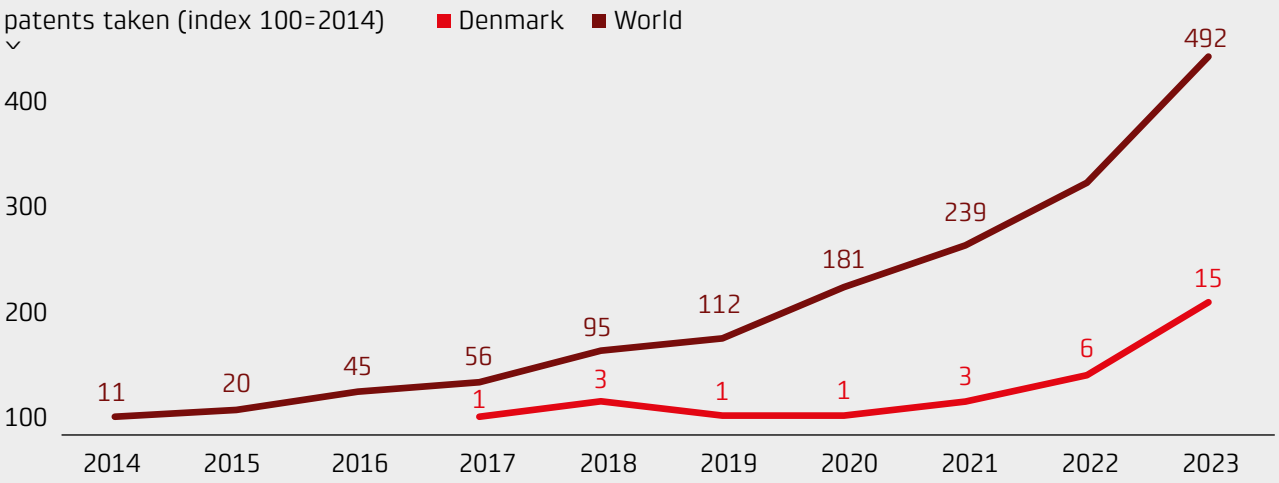
Although the absolute number of patents in Denmark might appear low, the trend is similar to the global one, albeit with a slower evolution compared to the world average. Thus, even a conservative projection only a few years into the future would still catapult the absolute number of Danish held AI-related audio patents.

Looking at the most frequent focus areas of the audio-related AI innovation, the category "Speech recognition" is, globally, by far the category that attracts the most attention and holds the greatest number of approved patents. Besides this category, many other focus areas in this technological niche also represent the top 10 across all audio-related patents. This can

“There is no doubt that manufacturers of headsets, hearing aids and other sound related products must continue and strengthen their use of AI in products. It is vital to remain ahead of the offerings of cheaper solutions while at the same time watch out for manufacturers of cellphone technology.

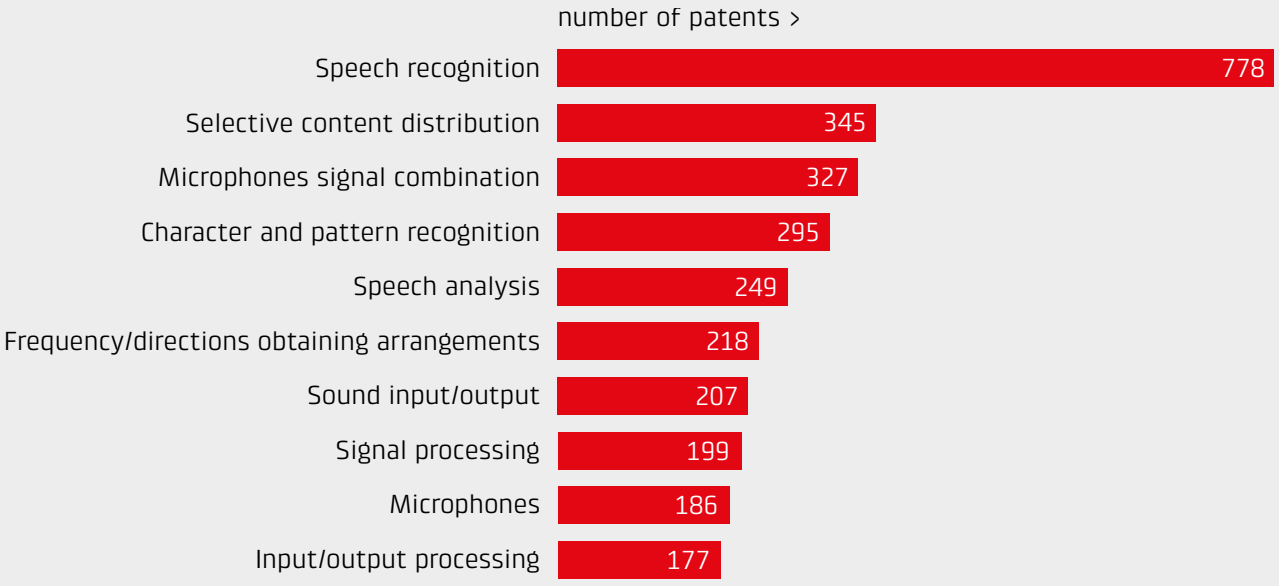
Birger Schneider, Chairman of the Board,
Danish Sound Cluster

Figure 5. Trend lines for AI-related audio technological innovation in Denmark and the world



Note: Index over the evolution in the number of approved and active patents in the intersection between AI and audio technology. The numbers in the graph show the absolute yearly numbers of new patents. 2014 = Index 100. Source: Danish Technological Institute based on data from PatSnap

Figure 6. Most frequent application domains for AI-related technological innovation in Denmark and the world



Note: Ranking of the most frequent "application areas" of patents in the intersection between AI and audio technology. Appli-cation areas are based on IPC and CPC-codes, but automatically generated by PatSnap. Source: Danish Technological Institute based on data from PatSnap

be seen as a sign that AI is in fact a megatrend that preoccupies many enterprises in the industry.

In Denmark, the most frequent technological focus areas within the intersection of audio and AI are related to the hearing aid industry. Although it seems that hearing aid companies are the drivers for AI innovation, interviews with stakeholders from the industry have shown that the possibilities to deploy AI in other parts of the sound industry are many. The patented innovation mainly linked to hearing aids can also be an expression of an industry where patents are more common than

Table 1. Examples of AI-based product enhancements

AI in audio experiences	AI in health and hearing	AI in acoustics and environment
• Personal assistant • Health tracking • Personalised fitting of device • Music suggestions by device • Automatic noise reduction • Real-time communication ehancement • Recognition of environment • Optimisation of battery time	• Personalised fitting of device • Hearing assessment • Optimisation of battery time • Personal assistant • Deep neural networks to improve understanding of speech • Voice recognition • Health tracking	• Acoustics simulations • Sound optimisation • Monitoring of environmental noise data • Soundscape analysis

Note: Use-cases for AI in product innovation. Source: Danish Tehcnological Institute

in other parts of the industry. For example, software like AI algorithms have a shorter time span of relevance than mechanical or pharmaceutical inventions.[7]

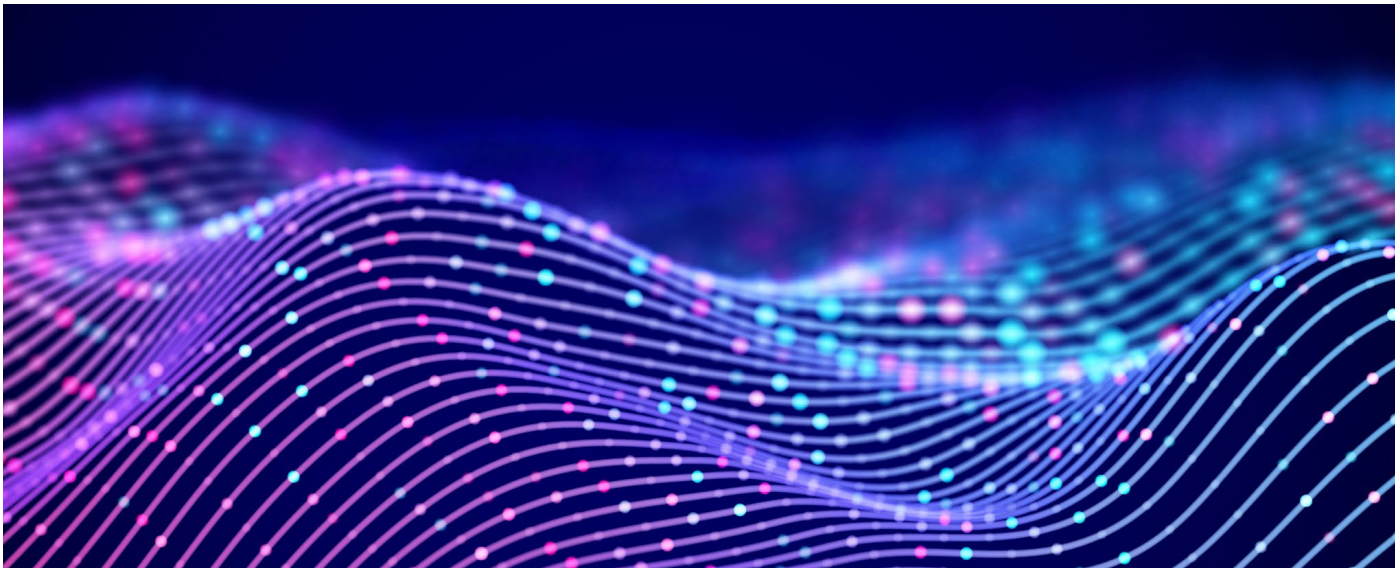
Examples of AI-driven technological solutions for the audio industry include speech enhancements through automatic signal treatment of noise and adaptation to surroundings, health tracking supported by for instance accelerometers measuring the movement of individuals wearing headsets or hearing aids, or the determination of sound directionality to enhance immersive audio experiences. Other examples are depicted in the table above.

There is no doubt that AI has a huge potential to impact the sound industry in the coming years. The strong upward trend reflects the growing interest in technology. Combined with the endless application possibilities, it underpins the need for Danish companies to consider how to approach AI and be aware of new developments in their specific line of business. In the following subsections, we take a closer look at some of the supporting elements that lay the foundation for capitalising on AI technology.

Chipsets are paving the way for AI innovation

The integration of AI technology harbors immense potential for innovating products and features within the sound industry. However, this integration requires substantial computing power and power consumption. Currently, the physical dimensions of hearables, such as hearing aids and headsets, impose limitations on the amount of computing power that can be embedded.

Chipsets are the building blocks that enable computing power in devices like smartphones, computers, and hearables. Integrated circuits or chips handle the data flow, storage, processing, and communication with the peripherals. Their properties and capabilities are critical



for the operational efficiency of electronic devices. In the context of hearables, chipset developments are crucial for enhancing the functionality.

For example, the advanced hardware from companies like NVIDIA, while highly effective, is often too large for incorporation into smaller devices such as hearing aids or headsets. Such limitations have spurred interest in the development of specialized chipsets that can accommodate the integration of AI into compact audio devices.

Along with this physical limitation, the EU has increased its focus on reducing the supply chain risks and supporting the development and manufacture of integrated circuits in Europe to reduce dependency on Asian suppliers. The development of chipsets is expensive and time-consuming, and large quantities must be in place for it to be profitable.

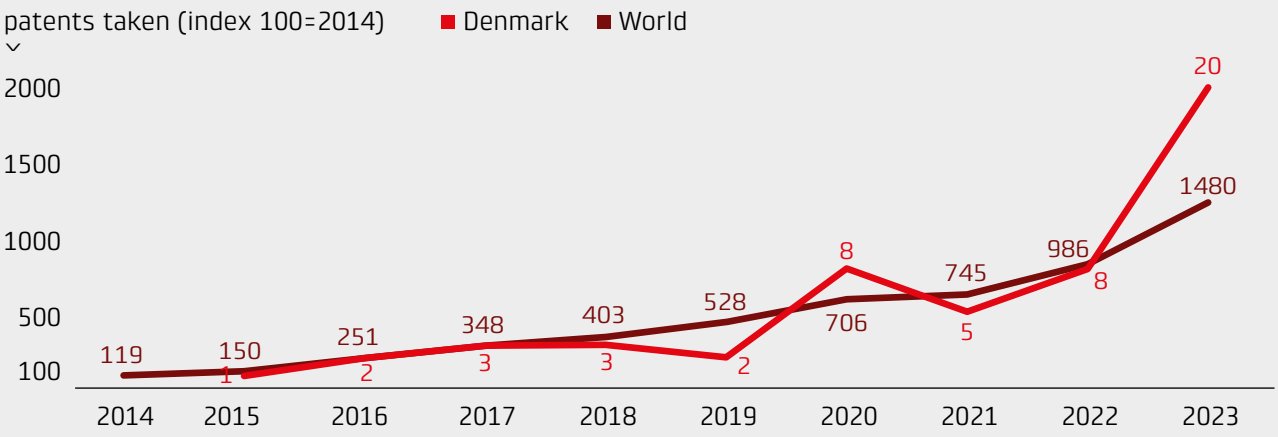
Presently, only a select number of companies produce these specialised chipsets, highlighting a niche but growing market. Forecasts by several market analysts project a compound annual growth rate (CAGR) of approximately 7 % over the next 5 to 10 years,[8] which indicates robust growth in this sector. Enterprises in the sound technology field must therefore assess the evolving market landscape for chipsets that are specifically designed to enhance audio functionalities through AI.

So how is it going with the development and dissemination of chipsets, and what does it mean for Danish companies working with hearables?

As depicted in figure 7, the trend is going upward for both Danish-held patents and internationally speaking. The trend line shows a drastic upturn from 2022 to 2023. Although sensitive due to the relatively small number of patents in absolute numbers, the curve indicates a sudden activity in the field.

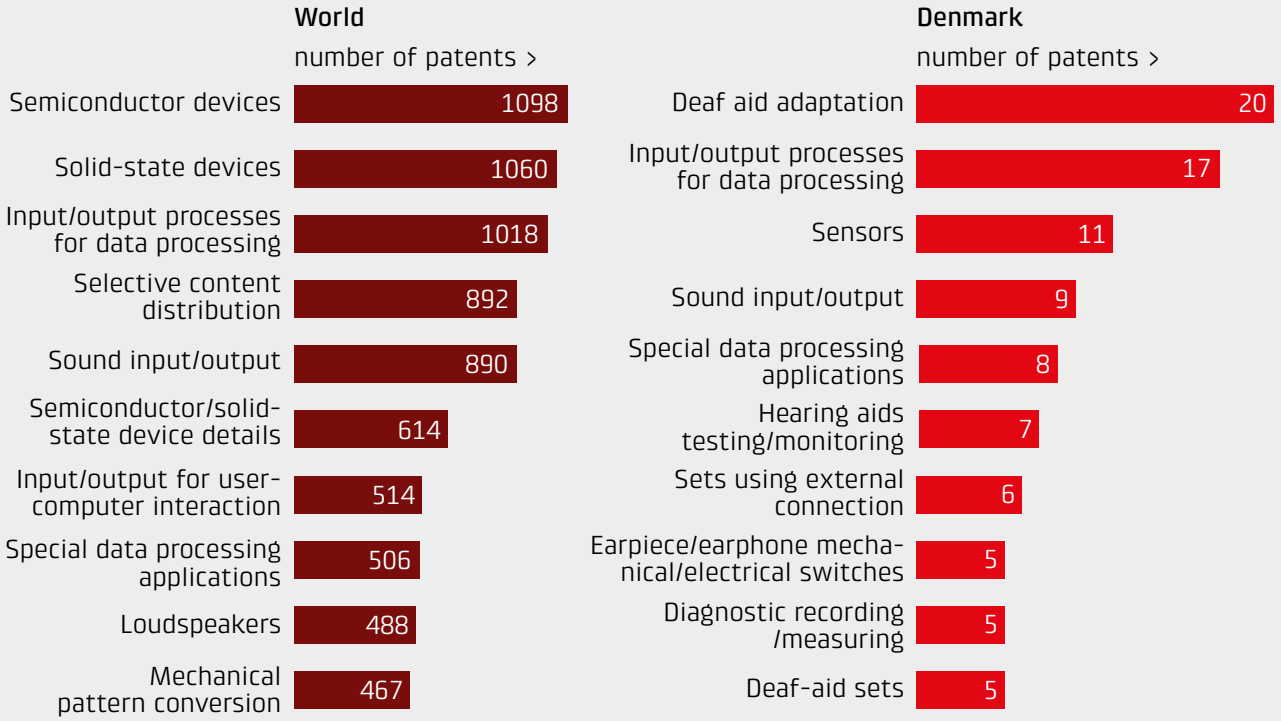
Taking a closer look at the most frequently used focus areas of the patents related to chipsets and audio

Figure 7. Trend lines for patented innovation in the intersection between chipsets and audio in Denmark and the world



Note: Index over the evolution in the number of approved and active patents in the intersection between chipsets and audio technology. The numbers in the graph show the absolute yearly numbers of new patents. 2014 = Index 100. Source: Danish Technological Institute based on data from PatSnap

Figure 8. Most frequent application domains for patents related to chipsets and audio in Denmark and the world



Note: Ranking of the most frequent "application areas" of patents in the intersection between chipsets and audio technology. Application areas are based on IPC and CPC-codes, but automatically generated by PatSnap. Source: Danish Technological Institute based on data from PatSnap

reveals that broad categories like semiconductor devices and input/output processes for data processing are among the most common (see figure 8). Not surprisingly, the hearing aid industry is dominating the picture when examining the most frequent focus areas of the Danish companies in the domain.

Danish enterprises in the chipset design and audio technology sectors are poised to capitalise on the increasing global demand for AI-enabled audio devices. The development and implementation of specialised, compact chipsets for products like hearables is an area where these companies can set industry standards, leveraging their strong capabilities in innovation and precision engineering. The European Commission's adoption of the European Chips Act is likely to mobilise significant resources in both public and private funding to bolster Europe's research, technology and industry for semiconductors.[9] The political prioritisation of the technology is therefore also likely to foster innovation and collaboration, which will also benefit the Danish sound industry.

However, the market for chipsets is a high-volume price-sensitive market, meaning that only the largest enterprises are collaborating with the manufacturers. But as depicted, new upcoming enterprises developing chipsets might hold possibilities that are worth examining.

Collaboration between chipset producers and audio technology firms can become a steppingstone in fostering product innovation and accelerating development cycles. By investing in research and focusing on the integration of advanced chipsets into audio products, these companies can enhance their competitive edge in a rapidly evolving market.

Data: a prerequisite for AI applications

Another important prerequisite for harnessing the potential of AI technology is large amounts of data. This is both for "training" and "testing" of AI algorithms.[10] The caliber of the data employed for training algorithms is pa-

ramount, as it directly influences the accuracy, efficiency and reliability of the output generated by the algorithm.

For instance, to develop AI models that can understand how humans hear – which can serve as a foundation for AI-driven features that adapt signal content and volume according to a person's current surroundings - one needs data for training and testing.

The Danish hearing aid manufacturers hold large amounts of high-quality data about human hearing based on real hearing tests. This data holds great business potential and might also partly explain why the hearing aid industry in Denmark is a frontrunner in patented AI technology across all industry sectors is.[11]

However, acquiring or getting access to relevant data can be a challenge. Due to the General Data Protection Regulation, it is difficult to get access to real patient data from e.g. hearing tests. Among other factors, this could drive a trend towards using artificial data generated from original data, with a model trained to reproduce the characteristics and structure of the original data – also referred to as synthetic data.[12]

The usage of synthetic data holds great potential for companies looking to develop AI-based technological features for audio products. Synthetic data based on simulations can reduce the product development phase by cutting out (or minimising) the gathering of real-world data from test scenarios and make it possible to run many more scenarios, increasing the precision and thus also the output of the algorithm. But leveraging the potential of synthetic data can in many cases require talent with highly specialised competencies and insight into the realms of both AI and audio.

AI and the future of sound

The integration of AI into the sound technology industry presents transformative opportunities that extend beyond mere product enhancements. This section has highlighted the various dimensions through which AI is poised to impact the industry, from technological innovations to the essential prerequisites for AI applications.

The surge in AI-related patents underscores the growing interest and investment in this area. The development of specialised AI chipsets is crucial, as they provide the necessary computational power for advanced AI functionalities in compact audio devices like hearing aids and headsets.

The rapid advancement in AI and machine learning technologies offers significant potential for innovation within the sound industry. AI-driven product features, such as personalised audio experiences, real-time sound adjustments, and automated audio content creation, can set new standards in user experience.

High-quality data is the cornerstone of effective AI applications. The Danish hearing aid industry, with its extensive repositories of hearing-related data, holds a competitive advantage. This data is indispensable for training and testing AI algorithms, ensuring they deliver precise and reliable results. But the use of synthetic data also opens new avenues for innovation, enabling the creation of highly accurate models without the constraints of real-world data collection.

The recently adopted European AI Act[13] will also impact the opportunities and the ways of working with AI. Among other things, it sets up regulations on the kind of data used for specific purposes in AI. The implications of the European Policy thus, are important to be aware of when exploring the potential of AI.

That said, the ability to integrate AI seamlessly into audio products will likely become increasingly important, and enterprises ought to explore the potential of AI.

In conclusion, the innovative potential of AI in the sound industry is vast, offering pathways to enhanced product functionalities and new market opportunities. Danish companies, leveraging their existing strengths and focusing on AI-driven innovation, can maintain and even extend their leadership in the global sound technology arena.

Immersive audio: new opportunities for niches of the industry

Some argue that immersive audio is not a new technology. Sophisticated audio technology that creates a multi-dimensional audio experience, enveloping the listener by simulating sound from multiple directions and distances to enhance realism or create a three-dimensional auditory environment has been around for a long time, exemplified by surround sound systems.

Despite this, stakeholders in the audio industry still have their eyes on the evolution of the technology. However, rather than traditional surround sound, the focus now is on creating immersive audio experience in headphones and earbuds.

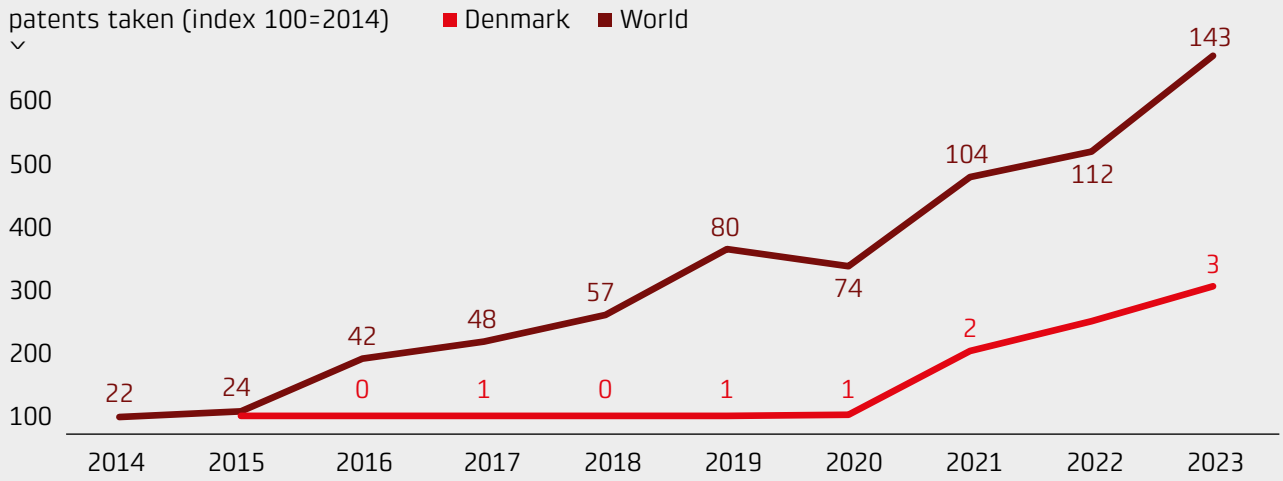
Data suggests that people today are wearing their headsets and earbuds for longer and longer periods. 58 % of respondents stated that they are using earbuds daily, according to a 2023 survey from Qualcomm.[14] An immersive sound experience in your headset can bring about a more natural sound experience, which could make it easier and more common for more people to wear earbuds or headsets.

Thus, building the immersive experience of sound coming from different directions has the potential to impact the industry by making headsets more attractive to a broader audience. Additionally, in terms of virtual meetings, the evolution of immersive audio can bring about a renewed and enhanced experience to the users. Finally, immersive audio also has potential for creating soundscapes in public places.

The trend for innovation activity within the realm of immersive audio is unmistakably on the rise, emphasising a growing interest in the technology. This upward trend is visually represented in Figure 9, which plots the trajectory of immersive audio innovation activity, comparing the development in Denmark with the global trend.

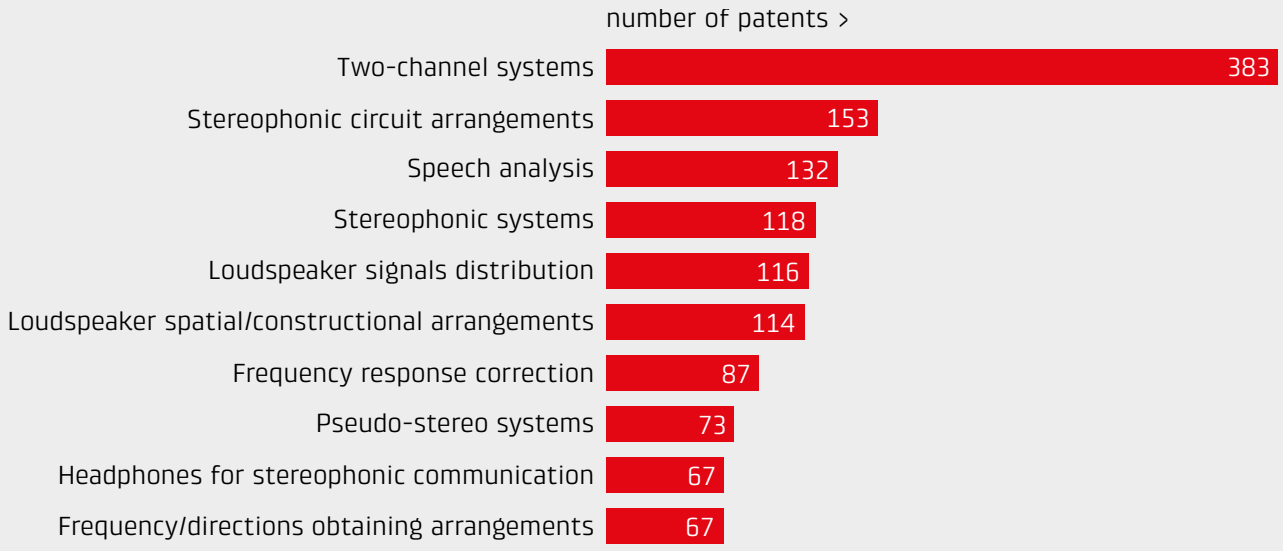
The push towards immersive audio is further bolstered by the widespread adoption of the Dolby Atmos format across various platforms, including Apple, Tidal, Spotify, Netflix, and HBO. Dolby Atmos not only enhances the audio experience by providing a more dynamic and immersive soundscape but also incentivises creators by offering higher streaming fees for Atmos music on platforms like Apple Music. This global enthusiasm for

Figure 9. Trend lines for patented innovation on immersive audio in Denmark and the world



Note: Index over the evolution in the number of approved and active patents related to immersive or spatial audio. The numbers in the graph show the absolute yearly numbers of new patents. 2014 = Index 100. Source: Danish Technological Institute based on data from PatSnap.

Figure 10. Most frequent application domains for patents related to immersive audio



Note: Ranking of the most frequent "application areas" of patents for immersive or spatial audio. Application areas are based on IPC and CPC-codes, but automatically generated by PatSnap. Source: Danish Technological Institute based on data from PatSnap.

Dolby Atmos compels the Danish audio industry to consider innovative responses to these trends.

Another significant development is the impact of immersive audio within the studio industry. Studios, both small and large, are transitioning from traditional two or four-channel setups to multi-channel systems that adhere to the Dolby Atmos standard. This shift reflects a broader trend towards more complex and immersive audio production techniques, which are becoming the industry standard.

Despite the global enthusiasm, Danish innovation in the realm of immersive audio appears relatively subdued, with a very limited number of patents approved annually. This modest activity suggests a focus on other priorities within the audio technological field or alternatively, innovation activity that does not become patented.

The predominant application domains for immersive audio technology are notably centered around "two-channel systems", followed by "stereophonic circuit arrangements" and "speech analysis", as depicted in figure 10. This distribution indicates a strong inclination towards enhancing the stereo audio experience and improving voice interaction within immersive environments. The focus on these areas could reflect market demands for higher quality personal audio experiences, particularly in consumer electronics.

Historically, Denmark has been, and still is, a bastion for high-quality speaker systems. However, the data suggests that the application of such systems to immersive audio reproduction is where international companies outside Denmark are aggressively innovating. Nevertheless, Denmark's heritage and expertise in audio engineering could be strategically leveraged, but that might presuppose thinking in new products and developing strengths in particular niches.

In conclusion, while Denmark currently shows limited activity in the immersive audio patent landscape, the foundational knowledge and historical strength in audio technology could provide a solid platform. For companies with a tradition of working with spatial audio, particularly in the personal audio device sector, changing their focus to other markets and new types of clients might bring about new opportunities. Danish companies have competencies in the field that, if utilised differently, could bear new opportunities

Table 2. Examples of use-cases for immersive audio

Use-case	Description
Immersive audio experience in headsets	Provides a multi-dimensional audio experience, enhancing realism and engagement for the user and bringing the surround experience to different locations.
Immersive soundscapes	Creates dynamic and interactive audio environments in a limited public or private space for enhanced ambiance.
Immersive sound in online meetings	Improves clarity and spatial distinction of voices in virtual meetings, simulating a real-room presence.
Traffic safety while wearing headsets	Integrates spatial and augmented audio to help users maintain awareness of their surroundings, enhancing safety.

Note: Examples of use-cases for immersive audio based on inputs from interviews with industry stakeholders. Source: Danish Technological Institute.

Bio monitors in audio products are on the rise

Biomonitors represent a class of technology that uses biological markers to monitor various health parameters. In the audio industry, this technology becomes particularly relevant due to the natural suitability of the ear for measuring body-related parameters such as movement, pulse, and more. The proximity of ear-based devices to blood vessels makes them ideal for non-invasive monitoring.

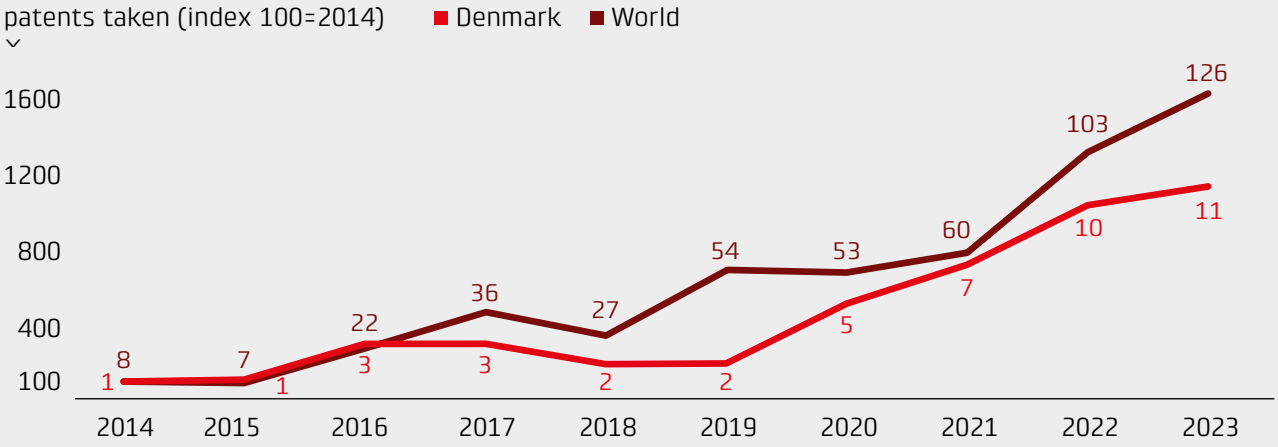
The increasing consumer focus on personal health, including mental well-being, general health tracking and longevity, aligns well with the integration of biomonitoring in audio devices. This trend taps into the growing awareness and consumer demand for health-related technologies that are seamlessly integrated into everyday life.

As an example, Apple has increased their focus on health tracking over the years with new possibilities to track sleep patterns, psychical activity, and other personal health parameters. This suggests that the market is growing.[15]

The innovation activity in biomonitoring technologies shows a significant upward trend. Also, when zooming in on innovation activity at the intersection between biomonitors and audio technology, the trend is pointing upwards. As depicted in figure 11, data indicates a particularly sharp increase in related innovation globally from 2021 to 2023. This surge suggests that companies worldwide recognise the substantial market potential, which is likely also spurred by the increased usage of headsets and hearing aids, as well as the new possibilities unleashed by the evolution of AI. The convenience offered by these devices, as opposed to more intrusive gadgets like watches, underlines their potential for widespread adoption in health monitoring.

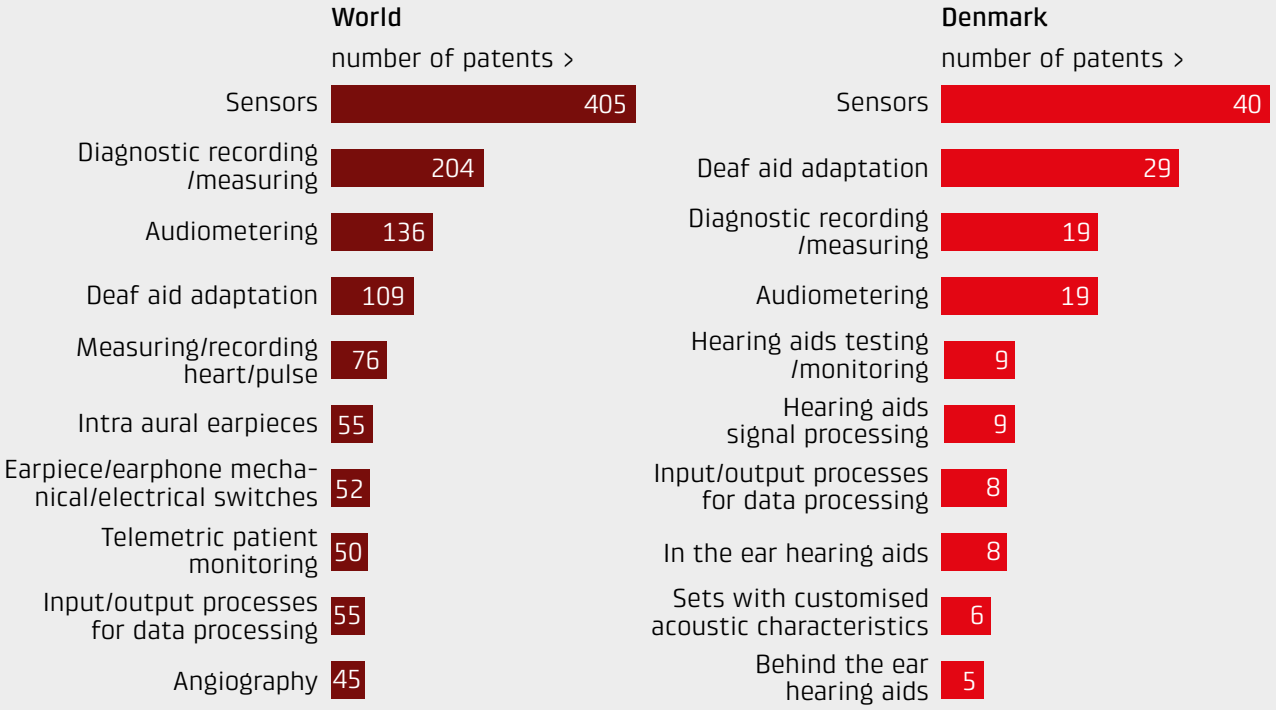
The most common application areas in this field include "sensors" for continuous health monitoring, "diagnostic recording/measuring devices" capable of detecting health anomalies, and "audiometering" to assess hearing functions. Understanding this chan-

Figure 11. Trend lines for patented innovation at the intersection between biomonitors and audio technology in Denmark and the world



Note: Index over the evolution in the number of approved and active patents in the intersection between biomonitors and audio technology. The numbers in the graph show the absolute yearly numbers of new patents. 2014 = Index 100. Source: Danish Technological Institute based on data from PatSnap.

Figure 12. Most frequent application domains for patents related to biomonitors and audio in Denmark and the world



Note: Ranking of the most frequent "application areas" of patents in the intersection between bio monitors and audio technology. Application areas are based on IPC and CPC-codes but automatically generated by PatSnap.
Source: Danish Technological Institute based on data from PatSnap.

ge involves recognising the broader shift towards multifunctional personal devices in the health and wellness sectors.

In Denmark, similar trends are observed with the addition of "deaf aid adaptation", reflecting the strong innovation and patenting culture within the Danish hearing aid industry.

Danish audio companies, especially those already entrenched in the hearing aid or headset market, are well-positioned to capitalize on this trend. By leveraging their expertise in audio engineering and integrating biomonitoring technologies, these companies can offer enhanced products that not only improve hearing but also monitor vital health parameters. This dual functionality could cater to a broader market, encompassing not just individuals with hearing impairments but also the health-conscious public.

In conclusion, the convergence of biomonitoring and audio technology presents a significant opportunity for Danish companies. By aligning their product development strategies with the ongoing trends in health technology integration, these companies can lead in an emergent market niche. This approach not only reinforces their standing in audio technology but also expands their reach into the health and wellness sector, promising growth and innovation in an increasingly health-aware global market.

Bluetooth – new standards will change the market

A new Bluetooth standard is on its way. And with it comes a new feature that will likely influence the way we consume audio and use audio products.

Auracast is a Bluetooth feature that essentially allows a source device, like a TV or phone, to broadcast one or more audio streams to an unlimited number of audio receivers such as earbuds, speakers or hearing aids. Owners of these devices can then choose which

audio stream(s) they want their listening device to tune into.[16]

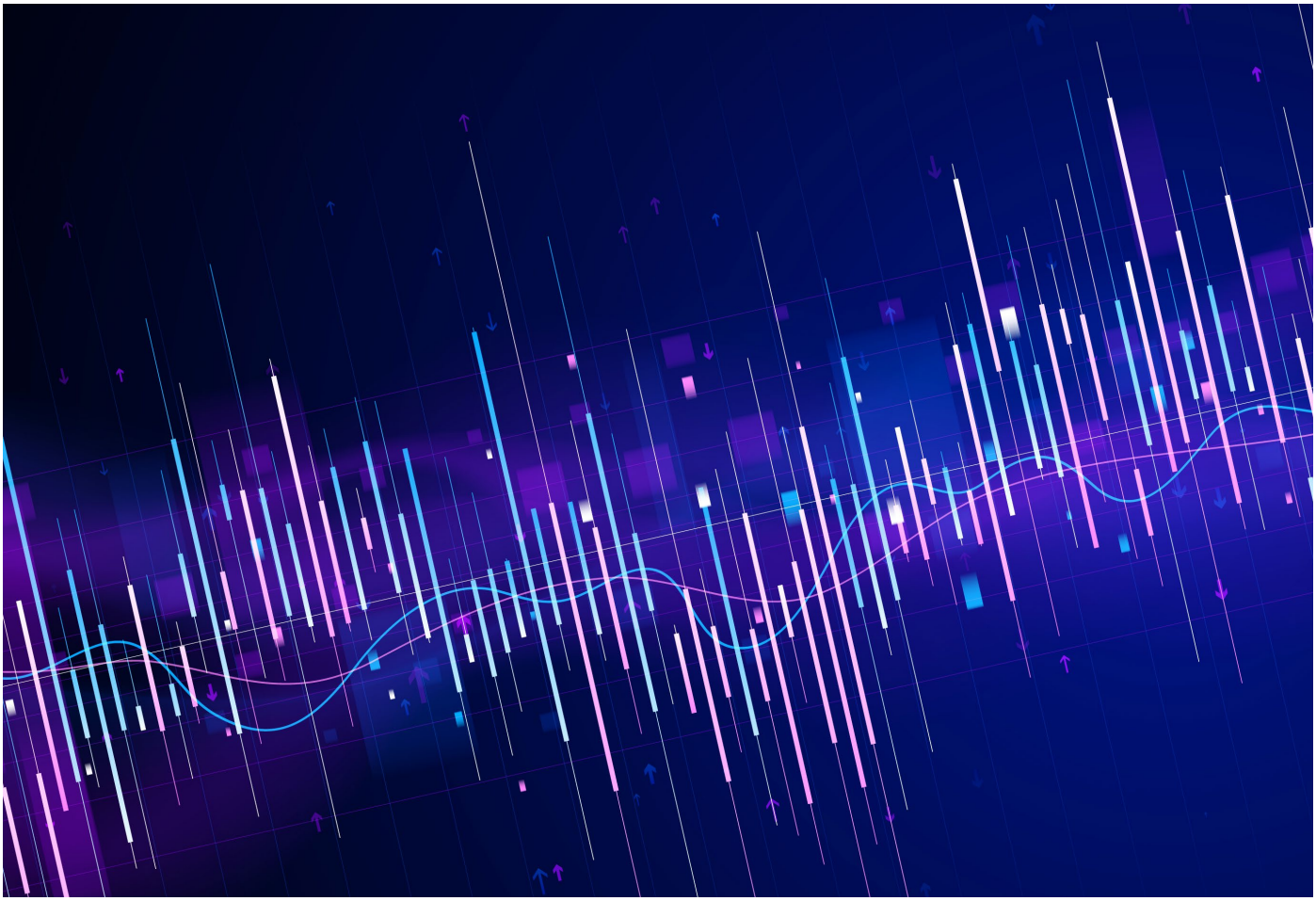
Imagine being in a loud sports bar and not being able to hear the football match on the television, in the local church and not being able to hear the preaching, or at the train station and unable to hear the announcements.

ABI Research forecasts that by 2027 there will be 3 billion Auracast-enabled transmitter and receiver devices globally, and that by 2030, 2.5 million Auracast broadcast audio locations will be deployed worldwide.[17]

If these projections hold true, the new Bluetooth standard and the Auracast feature hold the potential to greatly change the way audio is consumed and the way audio devices are used.

The possibilities with this technology tap into a number of other trends; most prominently the increased interest in devices that can support hearing,[18] but also the greater convenience of the feature.

It seems obvious that enterprises working with audio devices ought to support the new standard in their products. However, there might be a great new potential for audio companies that come up with additional features and possibilities utilising Auracast, which can be built into audio products. For example, adaptive volume and clarity control that can adjust the volume based on ambient noise levels, hearing health analytics where listening habits and Auracast interactions provide insights into hearing, or multi-source audio mixing that allows users to mix audio from multiple Auracast broadcasts simultaneously.



Chapter 3

Megatrends in consumer behavior and expectations

Innovation should, to some extent, reflect the needs and wants of the end-users. Therefore, it is important to understand which mega trends affect the behavior and expectations of the consumers of audio products and solutions to steer the strategical innovations efforts of Danish companies working with sound technology.

Convenience is the keyword for many consumers

In the rapidly evolving landscape of consumer preferences, convenience has ascended to become a paramount consideration. This seems to be the general feeling among companies working with consumer electronics, but also among other parts of the sound industry. However, convenience can mean different things in the sound industry, spanning from ease of connectivity of the device, through intuitive user-interfaces, to streamlined sales processes.

A 2018 PwC-study concludes that seamless transition between devices (from tablet to smartphone to desktop) is a baseline expectation to most consumers today.[19] This growing tendency holds significant implications for producers of audio technology. Understanding and integrating convenience into product design and service delivery can set a company apart in a competitive market.

The Qualcomm 2023 State of Sound Report underlines this point, revealing that 68 % of consumers desire a single wireless audio device catering to multiple uses.[20] This insight not only highlights the demand for multi-functional devices, but it also illustrates the overarching consumer preference for simplicity and convenience. Also improved device range for wireless devices has become more important to consumers.

And not only amongst private consumers is convenience important. The same report from Qualcomm shows that evolving work environments are driving demand for devices which help them hear and be heard both in the office and in other work environments.

In the realm of audio technology, products that simplify user experience and seamlessly integrate into daily life seem to be increasingly favoured over those offering superior sound quality alone.

This trend is evident in the success of enterprises like Apple and Sonos. Although audio products from other brands might have better sound quality, the convenience offered by the ecosystem of interconnected devices, services and user interface offers unmatched ease of use, significantly enhancing consumer appeal. Similarly, Sonos has captured a substantial market segment by providing easily configurable sound systems that deliver a hassle-free audio experience.

Also, when looking at the sales process, convenience becomes increasingly important. With Amazon poised to enter the Danish market, a focus on convenience will be crucial. Amazon's business model, which centres on consumer convenience through easy accessibility and rapid delivery, will set a new benchmark in customer service and satisfaction, meaning that the requirements for the purchasing experience are likely to increase in the future.

There is a clear opportunity for market share gains by focusing on consumer convenience in the production of audio technology. While high-quality sound remains im-

Table 3. Strategies to enhance consumer convenience

Strategy	Description
Enhanced Connectivity	Ensure devices are universally compatible and can communicate effortlessly across various platforms and ecosystems.
Streamlined Ecosystems	Develop products that are part of a broader, integrated ecosystem, allowing for smoother interaction and functionality.
Simplified Sales Processes	Make the purchasing process as straightforward as possible, from initial consideration to after-sales support.
Intuitive User Interfaces	Design user interfaces that are simple to use and require minimal learning curves, enhancing user engagement.
Adaptive Technology	Integrate adaptive technology that adjusts to user preferences and usage patterns over time, improving the user experience.
Efficient Customer Support	Provide quick and effective customer support to resolve issues and answer queries, thus enhancing overall user satisfaction.

Source: Danish Technological Institute

portant, the ability to offer products that are user-friendly and integrate seamlessly into daily life is likely to be a more significant determinant of success in the current market landscape. Producers might gain a more competitive edge by realigning their strategies and product development efforts to prioritise convenience, ensuring they meet and exceed the evolving expectations of the consumers. In summary, many enterprises should be aware of the significance of convenience as an imperative factor for consumers.

The demand for sustainability is on the rise

A great amount of research has cast a spotlight on consumers' attitudes towards sustainability in recent years. The proportion of consumers who care about sustainability is not insubstantial. Although there seems to be limited research that specifically targets audio products, there is a great deal of market insights from consumer goods, consumer electronics, and retail that can pinpoint the tendencies among consumers in general.

41 % of US consumers actively seek out brands with strong social and environmental values,[21] and over the past five years, there has been a 71 % rise in online searches for sustainable goods globally.[22] Although these numbers are taken from an American context, there is no reason to believe that the shares of consumers interested in sustainability in Europe and the Nordics are smaller – if anything, the contrary.

One thing is the awareness of sustainability, but what about consumers' inclination to pay more for a sustainable product? Recent market research carried out by Capgemini shows that varying between different generations, 34 % to 49 % are willing to pay more for a product they perceive to be more sustainable.[23] Not surprisingly, the baby boomers hold the smallest share, while the millennials hold the greatest share.

Interviews with stakeholders in and around the audio industry confirm the findings. Distributors of audio products increasingly experience that consumers are seeking products that are energy efficient and made with the most eco-friendly materials possible.

Stakeholders in the industry have also experienced an increased interest and awareness in building sustainable materials in sound insulation, and, in general, an increased interest in biogenic materials like wood.

European legislation setting higher requirements for the repairability of consumer electronics[24] further supports the trend towards higher demand for sustainability, both in the private and professional domain.

There seems to be an impression in the industry that Danish producers of consumer electronics are ahead of many Asian and American competitors in terms of sustainability.

Being ahead of the competitors, when it comes to sustainable practices and the increasing demand for sustainable products and solutions, shows that enhancing a focus on developing sustainable practices and betting on inventing or developing sustainable materials and products might bring about a competitive advantage in the international market, indicating an obvious area for innovation in the years to come.

Increased awareness of noise pollution and sound solutions as a factor affecting physical and mental health

The relationship between sound and health has garnered significant attention in recent years, highlighting both the detrimental effects of noise and the therapeutic benefits of certain sounds. This evolving awareness presents opportunities for the sound technology industry to innovate and cater to emerging consumer needs.

Noise pollution, particularly from traffic, has been extensively studied and linked to a myriad of health issues. Academic research has demonstrated that chronic exposure to traffic noise can contribute to serious health conditions, including strokes, cardiovascular diseases, and even cancer.[25] [26] These findings emphasise the critical need for effective noise management and mitigation solutions.

Conversely, there is a growing body of evidence supporting the positive effects of natural sounds and music on mental health. Natural soundscapes, such as bird songs or flowing water, have been shown to reduce stress levels and lower annoyance.[27] Music therapy is increasingly recognised for its potential to increase wellbeing, further underlining the beneficial role of sound in mental health.[28]

Recent neurological studies have further advanced our understanding of how sound solutions can alleviate mental stress and improve cognitive function.[29] This scientific validation opens up new avenues for the development of sound-based therapeutic applications aimed at stress relief and mental well-being. Integrating these findings into product innovation could position companies at the forefront of health-focused sound technology solutions.

The impact of sound on health has become more present in the public debate. Although actual studies or data on the public interest and consumer perceptions of the subject seem limited, many stakeholders in the industry experience a noticeable increase in interest from both private individuals and professionals. Consumers are increasingly seeking products and solutions that can mitigate the adverse effects of noise or harness the positive impacts of sound to promote mental well-being.

For companies in the sound technology industry, this heightened awareness presents a substantial business opportunity. Innovations that address noise reduction or enhance the positive effects of sound can meet this growing demand. Products such as noise-cancelling headphones, soundproofing materials, and therapeutic audio devices are positioned to attract health-conscious consumers.

By exploring and investing in innovations that address both the negative and positive effects of sound, companies can tap into a burgeoning market and

contribute to the well-being of their consumers. This approach meets a growing consumer demand, but also aligns with broader public health objectives, positioning companies as leaders in promoting mental and physical health through sound technology.

Features of hearing aids are slowly becoming part of headsets

A few years ago, over-the-counter (OTC) hearing aids were set to be a game changer for the hearing aid industry. However, the breakthrough has not materialised.

Over-the-counter hearing aids are hearing devices that can be purchased directly by consumers without a prescription or professional fitting, designed to address mild to moderate hearing loss. The initially perceived easier accessible and cheaper alternatives to hearing aids have not become a hit among consumers.

Stakeholders in and around the hearing aids industry believe that the technology is difficult to navigate due to the advanced technology and configurations available. Likewise, although cheaper than traditional hearing aids, OTCs are still rather expensive, meaning that many consumers stick to the traditional version.

It is necessary to note that OTC hearing aids are not yet permitted in Europe. Thus, when examining the impact and reception of OTC hearing aids, we focus on the American market, with a very different social safety net and health care system. This means that the experiences from USA cannot be translated directly to a Danish context.

Although OTC hearing aids have not been the blockbuster that they were once expected to become, they illustrate another emerging megatrend for the audio industry: namely, that features of hearing aids are slowly merging into headsets.

A range of enterprises and industry experts have their eyes fixed on the increasing demand for hearing enhancement in personal audio devices. It is already an area of interest for rather large segments of consumers. In China and India, more than 80 % of consumers state that hearing assistance/enhancement is likely to influence the selection of their next earbuds, while the same is stated for more than 50 % of consumers in both the UK and Germany.[30]

Wearing headphones and earbuds is becoming more common for consumers, thus they need to support various use-cases and should be wearable for longer periods of time. The earlier mentioned report also states that comfort in the ear for headsets has become the top purchase driver for the first time, as users are wearing their devices for longer periods than ever before.

Wearing something in the ear is no longer stigmatised as it once was, especially due to Apple's AirPods. All this put together underpins that the market is likely to grow in the coming years, and that the winners will be enterprises that can give consumers new features that make the headphones or earbuds wearable for longer periods.

Innovations that tap into the new ways people are using headphones and increase comfort will likely be interesting for other companies and consumers in the future.

Chapter 4

Megatrends in business models

Making changes to products and the changes brought about by some of the megatrends already discussed in this report can necessitate adjustments in business models. In the following subsections, we cover some of the ways companies can adapt their practices to the current industry landscape. The sections focus on the industry for consumer audio products and hearing aids but can be relevant for other parts of the sound industry as well.

Direct-to-consumer (DTC)

The Danish audio industry is renowned for its production of high-quality consumer electronics, encompassing a wide array of products from speakers and headsets to microphones. A significant part of the industry has a long history and has based its businesses on the traditional distribution-based business model as the primary sales channel, partnering with various intermediaries to reach end customers. This has been a great model for addressing the consumers for many years, as producers can focus on their core competencies and reduce the risk, since the distributors absorb some of that.

However, new winds are blowing in the consumer electronics industry, not only pushed by how new generations of consumers want to interact with the brands and their expectations for the customer experience,[31] but also due to new competitors utilising the possibilities created by the digital and interconnected world. The rise of digital platforms and the increasing preference for direct interactions have catalysed a shift towards direct-to-consumer (DTC) strategies. A study by Capgemini from 2022 showed that consumers are more willing than ever before to buy directly from brands.[32] Especially the youngest generations of consumers are keen to order directly from brands.

While the tendency might not have gained much traction in the Danish audio industry, the shift is a global phenomenon that is already widespread, and it offers both opportunities and challenges.

So, how can Danish audio companies leverage new business models like DTC to enhance their market position and meet the evolving demands of consumers?

To understand how the DTC-model can change a market, one can look to the automotive industry where many manufacturers of electric vehicles have had a significant impact on the market structure by focusing on DTC. Electric vehicle (EV) manufacturers such as Tesla have disrupted the automotive industry by – among

What is Direct-to-consumer?

DTC refers to selling products directly to consumers, bypassing traditional distribution channels such as wholesalers, retailers, and other intermediaries. This model enables companies to gain greater control over their brands, collect direct customer feedback, and increase their margins by eliminating the middlemen. On the other hand, it increases the responsibility for the producer in terms of logistics, customer service and marketing.

Source: Danish Technological Institute based on Chat GPT

Table 4. Pros and cons of the DTC business model

Pros	Cons
Increased Margins: Eliminates or reduces the share of intermediaries in the sales process, enhancing profit margins.	**Logistics and Customer Service:** Increased responsibility for managing logistics and providing end-to-end customer service.
Enhanced Brand Control: Direct interaction with customers enhances brand loyalty and recognition.	**Initial Setup Costs:** Higher upfront investment required for developing sales platforms and customer support infrastructure.
Customer Insights: Direct feedback facilitates agile product development and innovation.	**Channel Conflict:** Potential for conflict with existing distribution partners as the new model is implemented.
Market Responsiveness: Ability to quickly adapt to market changes and consumer preferences.	**Scaling Challenges:** Difficulties in scaling operations due to handling all aspects of the business internally.

Source: Danish Technological Institute based on ChatGPT

other things – selling directly to consumers and owning the entire customer experience, and many new EV brands are also deploying a DTC sales model.[33] Especially the new Asian brands position themselves differently in the sales ecosystem.[34]

Although not yet widespread in Denmark, there are already examples from the USA and southern Europe of producers of consumer electronics and retailers who have faced troubles during the last years, as Asian manufacturers, who used to be original equipment manufacturers or subcontractors, suddenly take their own products to market.

New entrants have easier access to the market with lower overhead costs and more agile business models. Therefore, Danish audio enterprises should be aware of how the model works and how new competitors can utilise it to win new market shares and consider if and how their own business models could be adjusted.

In an article from 2020, Harvard Business Review stated that the likely rise of voice interfaces is set to reshape commerce.[35] Currently, sales and marketing are optimised for screen-based interaction between consumer and the web. However, a platform shift towards voice interfaces can change the market once again.

There seems to be an obvious opportunity for the producers of the technology for personal voice assistants to consider how to integrate the technology into their own business models.

Adapting to the ecosystems

The landscape of consumer electronics is profoundly influenced by the ecosystems created by industry giants such as Apple, Google (Android), and Samsung. These ecosystems – networks of interconnected products and services – offer seamless user experiences and have set new standards for consumer expectations and market dynamics.

The comprehensive ecosystems developed by the tech giants are a new condition for the consumer electronics market. These ecosystems integrate hardware, software, and services, creating a unified and streamlined experience that enhances user engagement and loyalty. For instance, Apple's integration of the iPhone with other devices and services like the Apple Watch, MacBook, and iCloud exemplifies a strategic ecosystem that retains consumers within its brand.[36]

To exemplify the impact of ecosystems: In 2023, 50 % of owners of an Apple product had more than one iOS

device, while Samsung reported 21 % owning more than one Samsung Product.[37]

Additionally, the use of an ecosystem like that of Apple makes it impractical and difficult to change to another brand in terms of moving personal data from one platform to another.

Ecosystems are successful examples of how to leverage the consumer demand for convenient solutions. A PwC-study from 2018 showed that seamless transition from tablet to smartphone to desktop is a baseline expectation to most consumers today.[38] Having their devices and services interconnected enabling easy access and control across platforms and features.

Ecosystems currently have a large impact on the market and the circumstances for producers of audio consumer electronics. As a consequence of this, and due to consumers' desire for convenience and easy connectivity, Danish audio enterprises should consider how new products can be not only innovative but also compatible with the dominant ecosystems or how they can become part of them.

Circular business models are on the rise

Historically, the consumer audio electronics industry has operated on a linear business model. Products are manufactured, used, and then discarded, leading to significant waste and environmental degradation. Often, the parts that are used in items such as headsets are small, making them complicated to repair. However, with rising environmental awareness and regulatory pressures, there is a compelling need to adopt more sustainable practices, which emphasise the reuse, refurbishment and recycling of products and components.

Also, larger segments of consumers are beginning to search for products and businesses that are perceived as sustainable. In 2023, Capgemini found that 60 % of respondents in a large survey had bought products from organisations that are perceived as sustainable – and for the youngest consumers (Gen Z) the share is 71 %.[39] The same study found that 32 % of consumers dislike consumer electronics products that are not sustainable.

Examples of circular business models

Product as a Service (PaaS): Companies like Bang & Olufsen and Bose offer high-quality products on a subscription basis. This model ensures that products are returned and refurbished, extending their lifecycle.

Modular Design: Some innovative firms have started designing audio devices that are modular, allowing consumers to replace or upgrade specific components instead of the entire device. For example, AIAIAI and Sennheiser.

Take-Back Schemes: Several audio companies (e.g. Harman and Sony) have implemented programmes where customers can return end-of-life products directly to the manufacturer for recycling or refurbishing.

Source: Danish Technological Institute based on ChatGPT

Another important point is that E-waste[40] is the fastest-growing solid waste stream in the world,[41] emphasising the need for sustainable practices and new business models that reduce the carbon footprint of the industry.

So, the question is, how and when circular business models can be relevant for producers of audio products?

Circular business models in the audio industry can involve an array of elements, including designing products for longevity, repairability, reuse, and recyclability. These models not only reduce environmental impact but also offer economic benefits by maximizing resource efficiency.

It seems that many companies in Denmark have already embraced circularity in one way or another. Circular business models are not just about regulatory compliance or waste reduction. They represent a strategic differentiation opportunity in a competitive market.

In conclusion, the shift towards circular business models in the consumer audio electronics industry offers both challenges and substantial opportunities. Innovation in product design and business practices that incorporate circularity and sustainability is well-positioned for the future. With a continued focus on repairability, energy efficiency, sustainable materials, etc., Danish enterprises have a chance to get a head start, and sustainability can be a competitive edge in the increasingly conscientious market.

Coopetition on evolving ODMs

As already established, the consumer electronics market, including the market for audio products, is increasingly dominated by a few, large players, making it difficult for smaller brands and producers to compete.

A way to increase competitiveness in such a market might be by pursuing a strategy of coopetition.[42]

An example discussed during the project process was coordinated use of OEMs.[43] Competing against the large global audio brands is tough. The large brands have their own and highly skilled OEMs because they provide high quantities, thus making it fruitful for them to train the OEMs and increase their level of competencies.

The same is not possible for smaller companies. But by coordinating with competitors and helping each other train OEMs and together provide sufficient quantities, it can reduce costs for all parties and thereby make them more competitive compared to the large, global brands.

This kind of collaboration among seemingly competing companies can be seen in other industry sectors. For

What is coopetition?

Coopetition refers to a strategic approach where competing organizations collaborate to achieve mutual benefits. This model allows companies to leverage each other's strengths, share resources, and access new markets or technologies. By working together, businesses can drive innovation, improve efficiencies, and create value that would be difficult to achieve independently. However, coopetition also requires careful management of competitive tensions, clear agreements on shared goals, and robust frameworks to protect proprietary information and maintain competitive advantages.

Source: Danish Technological Institute based on ChatGPT

many years, BMW and Toyota have created value by collaborating and sharing knowledge on electric vehicle batteries, to fast-track development and thereby increase the market size.[44]

Academic research also shows that coopetition can enhance innovation and knowledge creation, cost efficiency and even sustainability under the right conditions.[45] Amongst the conditions highlighted are trust and effective coordination among members.[46]

Finding opportunities for collaboration among competitors might bring about new innovative practices and increased competitiveness. A closely tied Danish industry with good relations, even among competitors, can have a significant impact if well-coordinated. Danish sound enterprises could look to into sharing knowledge and sharing costs.

Chapter 5

Concluding remarks and general recommendations

The sound industry stands to be greatly influenced by emerging trends that promise to reshape the landscape in the coming years, as described in this report. The Danish part of the industry is poised to harness some of these trends based on its historical strength and specialised knowledge in audio technology, which serves as a robust foundation to capitalize on them. However, seizing the opportunities requires a proactive and strategic approach. The following recommendations are aimed at enabling Danish sound technology companies to navigate and leverage these developments effectively.

Leverage technological strongholds

Denmark's expertise in audio technology provides a solid platform to build upon. Companies should explore how their existing competencies and knowledge can be applied to exploit emerging technologies such as AI, bio monitors, Bluetooth advancements, and immersive audio. AI appears to hold a particularly significant potential across sub-sectors of the industry.

Explore new use-cases and markets

Innovation often thrives at the intersection of different domains. Danish companies should consider adapting their technologies for new applications. Bio monitoring in audio devices offers significant potential in the health and wellness sector, while immersive audio technologies can be employed in virtual meetings and public soundscapes, opening new market opportunities.

Respond to changing consumer behaviour

Consumer demands are evolving. Convenience, health tracking, and sustainability are prominent trends that stakeholders from the industry are observing closely. Prioritising the development of user-friendly products that integrate seamlessly into daily life may hold significant potential. Focusing on sustainable practices and materials could also provide a competitive edge as consumers become more environmentally conscious.

Embrace sustainability

Denmark is well-positioned to lead in sustainable practices within the audio industry. Companies should continue to innovate in areas such as repairability, energy efficiency, and the use of eco-friendly materials. Adopting circular business models not only addresses regulatory requirements but also aligns with growing consumer preference for sustainable products.

Foster collaborative innovation

Collaboration across sub-disciplines can unlock innovative potential. By working together, companies can share knowledge and reduce costs, particularly in areas requiring specialised expertise, such as AI integration and chipset development. This approach can enhance the competitiveness of Danish companies in a market increasingly dominated by large global players.

Adapt business models

Emerging trends necessitate a reevaluation of traditional business models. Direct-to-consumer (DTC) strategies, for instance, offer opportunities to build stronger customer relationships and increase margins. Companies should also consider how their products can integrate with existing ecosystems to meet consumer expectations for seamless connectivity.

Chapter 6

Methodology

This report is based on a robust intelligence methodology that combines qualitative and quantitative data from three complementary sources: in-depth industry interviews, desk research, and patent analysis.

Prior to this, a series of round tables with representatives from industry and academia were held to narrow down the most anticipated trends in each of the three categories of the industry (Audio Experiences, Acoustics and Environment and Health and Hearing Care).

Over 20 hours were spent interviewing Danish and global sound technology experts across functions like corporate leadership, R&D, product management, and business development. These interviews provided qualitative insights into the latest technological developments, consumer trends, and strategic planning considerations. While limited by potential expert biases and small sample sizes, the interviews enabled an insightful visionary perspective.

Desk research was conducted covering more than 20 recent market reports, articles, and scientific publications of relevance to the subject matter. This quantitative data revealed detailed market sizing and growth projections, while also granting access to cutting-edge research not yet widely known. Despite variability in research quality and some gaps in niche sub-domain coverage, the desk research furnished crucial market facts.

Lastly, an analysis of more than 600,000 of the latest (2014-2024) patent filings pertaining to audio and sound unlocked areas of innovation investment on a global scale. Though limited by time lags between early R&D and commercialisation, the patent analysis pointed clearly towards technological frontiers.

Together, these three intelligence sources enable both a data-driven perspective grounded in market realities as well as a visionary lens informed by technological frontiers and industry seers. This multi-modal approach ensures sufficient breadth, depth and forward-orientation for advanced strategic insights tailored to Danish sound industry leadership. The methodology furnishes the underlying rigor and validity for the identified trends and strategic recommendations.

Notes

[1] The extent to which innovation is patented varies across industries. For instance, in rapidly evolving sectors like software and algorithms, where intellectual property rights are challenging to enforce, patents as a measure for innovation can be less representative than in other industries.

[2] The Patent Database, PatSnap, which has delivered data for this analysis, uses an algorithm to estimate the value of patents based on a number of indicators, including duration of the patent, citations, industry sector and related licenses. For full description visit www.patsnap.com/glossary/patent-valuation.

[3] We refer to PatSnap's definition of "application domains," which categorizes patents based on their technological focus areas.

[4] OECD, 2018: Oslo Manual: guidelines for collecting, reporting, and using data on innovation, 4th edition.

[5] E.g. patents that contains both AI-related IPC or CPC codes and audio-related IPC or CPC codes.

[6] The trend line for AI technology patents is not illustrated in the report.

[7] IamIP: Emerging challenges of software & patents, www.iamip.com/emerging-challenges-of-software-patents

[8] See e.g. www.marketresearchfuture.com/reports/audio-ic-market-8624, www.skyquestt.com/report/audio-ic-market and www.kbvresearch.com/audio-ic-market

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Contributors

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