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The old economy listening to the new: E-commerce in Hearing Instruments[1]

Peter Lotz
Copenhagen Business School

E-mail: pl.ivs@cbs.dk

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Introduction

The global hearing instrument industry is a miniature industry: Small products, small players and small total turnover. Also, it is "old economy" with material products and human interaction. While not claiming that this industry is representative in any obvious sense, examining the impact of web-based trade in this small-scale industry may anyway allows us the learn interesting lessons about more economy-wide transformations.

The paper is organized as follows. It starts with an introduction to the product and to the industry. From the perspective of the manufacturers of the devices, the entire value chain is presented. This provides us the basis for a discussion of the different market interfaces. The remainder of the paper discusses the possibilities of e-commerce at each of these interfaces.

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1 This paper builds on earlier studies by the author of the industry. See e.g. http://brie.berkeley.edu/~briewww/pubs/wp/wp114.html or http://www.cbs.dk/departments/ivs/lotz/cisnois.pdf

The product

Hearing instruments (hearing aids) are electronic sound amplifiers. No more, no less. They pick up sound signals from the environment, process these signals in their amplifiers, and "inject" the amplified signal into the ear. A hearing instrument therefore builds on what remains of hearing ability. This ability may be substantially reduced, but the user cannot be totally deaf. In that case other therapies must be tried, such as surgery and cochlear implants.

Hearing instruments come in two different shapes: Behind-the-ear (BTE) devices, and custom or in-the-ear (ITE) devices. As indicated by the name, a BTE instrument sits behind the ear, or rather, the case with the electronics is placed behind the ear. In order to bring the amplified signals into the ear, a small tube leads the signal from behind the ear into the ear, where the tube is secured by a custom designed plug. The ITE instruments carry everything in a case that fits totally into the ear. This case is custom designed and the layout of the components is arranged according to the individual shape of the case. Over the past 25 years ITE instruments have become so small that some of them now are virtually invisible.

Fundamentally, the two types work the same way. They are made up of the same basic components: A microphone picks up the sound, an amplifier processes the signals, and a speaker transmits the amplified sound into the ear. A battery powers the devices. To control the device, switches and trimmers are needed, even though remote control and programming can substitute many mechanical parts.

Until recently, amplification was analog for all products. In 1995 two Danish companies (Widex and Oticon) introduced digital amplification. Now all major companies offer digital as well as analog instruments. We shall return to this change below.

Two decisive features of hearing instruments

That a product is small does not necessarily make it simple. On the contrary, it often difficult to produce very small versions of standard products. When the entire product is small, also parts must be small. This certainly goes for hearing instrument components. To produce microphones and speakers at the size of 1-2 millimeters is no trivial task. And even seemingly simple components such as mechanical trimmers and switches of the same size produced under very narrow tolerance ranges turns out to be the job of only specialists.

But, as most parts for hearing instruments are produced by specialists, they are available on the market. To become a manufacturer of standard, analog hearing instruments is therefore straightforward: You may buy all components on the market, so what you have to do is to take a cast of the customer's auditory canal, build a shell on this basis, then fit in the parts, and finally fine-tune the device for the customer.

However, to advance the state-of-the-art takes serious research and development. Any good hearing instrument builds on a delicate balance of technical restraints and auditory performances. The design is optimized over a range of technical possibilities. Interdependency between parts is high, so change of one part will immediately affect the functioning of the entire system. Add to this that it is not at all clear what is "optimal auditory performance".

It has long been a major challenge to choose the right way to amplify the sound. Just one (important) challenge: How to pick the right signals to amplify when the user is in a situation of multiple sound signals? For example, imaging the chaotic sound-picture at a cocktail party. Ideally, you want amplification of your immediate conversation partner. This is not easy in itself, but may with advanced amplification schemes (algorithms) or hardware (dual and/or directional microphones) be partially achieved. Still, in order to spot new conversation partners, you don't want to cut off all environmental noise. How to balance these concerns is a long-term challenge for the industry.

To produce a state-of-the-art hearing instrument therefore is simple, but to develop a better instrument is very difficult. This has been clearly demonstrated during the past 5 years with the development of digital amplifiers: The threshold for participating in this game has increased considerably. (We will return to the competitive situation below.)

As a fundamental characteristics of the industry the custom-design must likewise be emphasized. It is currently indispensable for a customer to have a hearing instrument fitted on an individual basis. Two features of the hard-of-hearing problem leads to this: As mentioned above, we have anatomically very different shapes of our inner ears, so to fit precisely a hearing instrument must be custom-made. (This has at least been the conventional wisdom which is now challenged as described below.) On top of that, also the hearing losses come in many different forms. You may, for example, loose the ability to hear only certain frequencies. To compensate a hearing loss is therefore much more difficult that to correct vision problems.

The hearing instrument business therefore builds on intimate contact to customers. Selling hearing aids without meeting the customer in real space has hitherto been unthinkable.

The Value Chain

These basic features of the industry frames the value chain: Instrument manufacturers have traditionally been mainly assemblers or integrators. Essential components has been produced by independent suppliers. That goes for standard parts such as batteries, but also for specialized components only for use in hearing instruments. Of particular interest are microphones and speakers for which production has been concentrated to basically one single supplier: The privately hold company Knowles (Chicago, US). Instrument manufacturers have tried to balance that monopoly either by internal production or by supporting the only other producer, the Danish company Microtronic. So far these attempts have not eroded the stronghold of Knowles. Analog amplifiers have likewise been available on the market, but

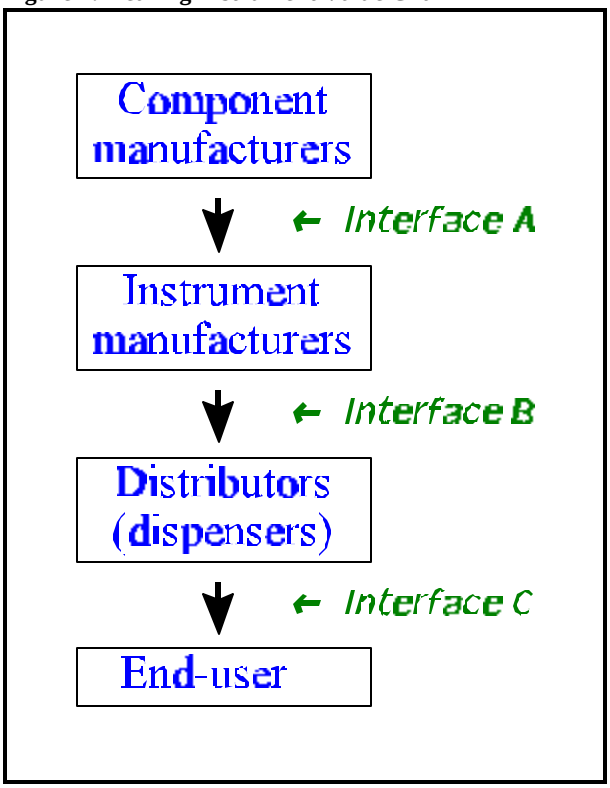
the new digital amplifiers have so far only been produced by the instrument manufacturers.

Globally, the hearing instrument manufacturing industry runs revenues of $1½ -$2 billion. The industry of hearing instrument manufacturers has traditionally been relatively fragmented. Until 5 years ago, two companies led the industry in terms of volume: Siemens (Germany) and Starkey (Minneapolis, US). Both held global market shares of app. 20 percent. A large group of second tier companies with 5-10 percent market share included Oticon, Danavox and Widex (all from Denmark), Philips (the Netherlands), and Phonak (Switzerland). Adding to these were a number of more local companies such as Beltone and ReSound in the US, and Rion of Japan.

Due to high development costs for digital instruments, this picture is now changing dramatically. Already before 1996 Starkey had quietly bought minor American companies, but it was the Oticon's acquisition of the Swiss company Bernafon that initiated the current merger process. Following this merger Starkey has intensified its acquisitions of American companies, also Siemens has bought some, ReSound (only founded in 1984, but bolstered by venture capital from Silicon Valley) bought an American high-tech start-up plus Viennatone (Austria), only to be bought itself in 1999 by the parent company of Danavox with which is was merged under the name GN ReSound. Also in 1999, Philips Hearing Instrument section merged with Beltone, and three minor American companies got together. The most recent and most spectacular event occurred in April 2000 when GN ReSound in a USD 400 million deal bought Beltone (including the former Philips activities) to form the second largest global player.

This leaves the industry far more concentrated than only 5 years ago with many small (especially American) companies wiped out. A handful of players now dominate the industry: Siemens (D), GN ReSound (DK), Starkey (US), and Oticon (DK). The Danish company Widex has not been involved in mergers, but this company probably is the single most successful hearing instrument manufacturer in this "digital" period and has achieved its remarkable growth organically.

Figure 1: Hearing Instrument Value Chain



This does mean, however, that these are large companies. Only Siemens and GN ReSound belong to diversified conglomerates (both operating fairly independent, though), all other hearing instrument manufacturers are independent firms. The larger ones employ 2,500 to 3,000 persons worldwide and have revenues in the range of $400 million.

Distribution of hearing instruments follows several, rather different models. For convenience, let us men-

tion only three: the North-European, the Central-European and the American. In Scandinavia and the UK, hearing instruments are provided free of charge as a part of the public health program. Distribution is mainly handled by audiological clinics at hospitals. In central Europe, a variety of labor-market based and other health insurances reimburse a large part of the cost of a hearing instrument. Distribution is managed by private, retailing audiologists, often organized in chains. In the US, most buyers carry the full costs of a hearing instrument. Only about 15 pct. get reimbursed from Medicare/Medicaid. Health insurances and HMOs generally do not cover hearing instruments. Instruments are sold by the so-called "dispensers", owned and/or staffed by either university-trained audiologists or "hearing instrument specialists" (with app. 6 month training in fitting hearing instruments). Attempts at building chains of dispensers have so far been unsuccessful in the US (but they do exist and we shall return to them below).

Generally, no matter which model, the distributors source the hearing instruments with the manufacturers or their local affiliates, who do the custom-part of the production on order. Despite different payment schemes, the ultimate fitting of the instrument is handled more or less the same way all over the world.

Finally, some words on the end-users. Loss of hearing is strongly age-related, so most customers are elderly people. Many are so old when they buy their first hearing instrument that they die before they have a chance to buy a second one. Furthermore, choosing the right instrument is very difficult, in part because of the above mentioned variation in types of hearing losses, in part because of the different life-styles of the users and the following differences in use. So potential buyers usually do not do comparison-shopping. Once they have entered the shop of a dispenser, they tend to rely on his advices.

This leaves a fairly simple value chain as depicted in Figure 1. There are only three market-places or "open market interfaces" in the system: Two business-to-business markets, and one business-to-consumer market. Interface A is where manufacturers source parts and components. Interface B captures the dispensers' sourcing of instruments. And finally interface C is the retailing. One may argue that there is one more interface, namely the relation between the manufacturer and its local representation. Doubtless, this relation will benefit from net-based communication, but since a large part of this communication will take place *inside* a company, it is not dealt with here.

E-commerce

Interface A

All of the above mentioned three markets are open to e-commerce, some more obviously than others, though. Least activity is apparently taking place at interface A, the supplier relations. While some kind of electronic ordering could be useful, it seems less likely that the internet allows for radically changed market processes. The kind of bidding that is expected in other B2B net-based markets (auto parts, pulp and paper) is hard to imagine when the number of components sources is rather small and most of the component-producing industries are concentrated into duopolies or even monopolies. In such cases, the costs of inviting offers are so small that buyers probably will not save by using a standard bidding

forum.

For another component, the essential chip that runs the signal processing, the story is different: Hearing instrument manufacturers design their own chips. The ability to design chips is a key competence in this industry. However, the production of chips is outsourced to foundries. Apparently, the web does not allow for radical changes in the business of contract manufacturing of such chips. Choice of supplier is based on much more information than simple prices, and long-term relationships are therefore expected. And since all hearing instrument manufacturers already are out-sourcing this activity, the emergence of "pure-play" foundries, offering this service, does not change the game, e.g. by allowing entrants to piggyback the incumbents.

Interface C

Skipping for a moment wholesale, and jumping to interface C, retailing,[2] the picture is somewhat different. Still, the product is very material and seems far from digitized product. And not only is it material, it currently is custom-made both in physical shape and amplification adjustment. Therefore, the internet apparently cannot be of must use. It has, however, the potential of changing the game substantially, both in the short term and in the near future. Let us discuss some aspects:

First, information about the products now flow freely on the internet. Not surprisingly, the manufacturers try to reach the end-users directly and create a "market-pull" effect. Reaching the end-users has been attempted before, but costs have been prohibitive. Therefore, brand awareness has been minimal. Probably no person without some relation to the industry would be able to mention the name of a brand. Now, potential buyers may search the internet for product-information. In itself, that probably is of little use. The specifications do not come in any standardized form and are generally impossible to understand. However, as a growing minority of elderly people become acquainted to the internet, they will begin bringing prints of manufacturer information to their local dispenser, challenging their authority. This goes for public services as in Scandinavia, where the introduction of digital instruments caused much nuisance at the hearing clinics since many people with hearing losses called the clinics, asking to be fitted one of these new, promising instruments. Public procurement systems, however, cannot respond so quickly to such demands, but want results of objective trials before a new product is brought into the restricted portfolio of dispensed products. And it goes for the small American dispensers, that has limited capacity to overview the entire range of available products, and simply has no experience with more that a hand-full of models.

The authority of this dispenser is certainly challenged, with the possible consequence that customers get more critical, maybe turning their back to uninformed retailers and demanding better service, including consumer testing for comparability. This again may cause changes in retailing, favoring dispensers with access to neutral assessments of brands and backed by specialist knowledge. One answer to such demands could be chains with centralized training and testing. If this demand leads to increased

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2 US retailing is a $2-$2½ billion business

transparency, manufacturers may lose opportunities for differentiation, leading to more heads-on competition.

Secondly, chains may be favored by sheer scale economies from running web-sites. If information-seeking on the internet becomes crucial, economic muscle is important in the maintenance and development of web-sites.[3] Web-features that may work this direction is web-based hearing tests that already now are appearing in more or less sophisticated versions.[4] Such features take resources to develop and maintain. Another feature, often based on such simple tests that relatives may complete (just checking a number of hearing-related questions), may be the issuance of dedicated gift certificates. A relative may on the web buy a certificate to a specific instrument, ship it as a gift for the hearing-impaired person that exercises the certificate with a local dispenser. This feature favors large chains since it requires a local chain-store. (This works much like the logic of flower delivery.)

Thirdly, even though the product itself cannot be digitized, actually an important part of the "package" that includes the instrument is digitized for many products: The adjustments of a hearing instrument is – as mentioned above – very individual and not trivial. To the degree that fitting is not mechanical but programmed, there may be options for web-enabled adjusting (and testing) of hearing instruments. The technology and business models for this seems not, however, to be available currently. And as long as customers anyway need to visit the dispenser for the physical fitting, it may not be all that relevant. But this takes us to the last point:

Fourthly, the possibility of trading electronically may direct the technological development in directions that facilitate such trading. Currently, two product innovations may be taken as examples of such scenarios: One is a disposable hearing instrument, developed by Songbird Medical with technology from the Sarnoff Corpotration and financially supported by e.g. Johnson & Johnson. This instrument comes in a one-fits-all physical shape with 9 different amplifications. A relatively simple hearing test may determine which amplification to chose, so in this case a personal call on a dispenser may not be needed. Similarly, the company Sonic Innovation of Salt Lake City, UT, has launched an instrument that is not disposable, but which has a soft, rubber-like, shell fitting most ear canals and which may be changed every three weeks. In terms of programming, it comes with a PalmPilot that can be wired to the hearing instrument for adjustments in amplification. Since both of these products need no physical fitting, they may be acquired via the web. Still, though, the electronic fitting may be too difficult to do without professional help. And, furthermore, current US laws forbid the sales of hearing instruments without audiological referral (similar regulation exist in most countries). None of these contenders therefore at this point in time dare challenge the current distribution channel, and none of them seem to be successful.

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3 Manufacturers may counter this by offering independent stores more or less pre-designed homepages on manufacturer-operated web-sites. As an example, Oticon runs the site digilife.com for this purpose. A next step would could be a web-service run by the manufacturers jointly.

4 See e.g. the German dispenser chain Kind at www.kind.de

The likely result is that while internet-based communication may cause changes the retail industry structure and increase transparency, it also has the potential of increasing the size of the total market, simply by offering more and better information on the products. In the long run, the opportunity of interactive communication may induce innovation in directions that facilitate e-commerce. But it may take many tries to develop a hearing instrument that allows for that.

Interface B

The interface between manufacturers and retailers is predominantly a purely market-based interface. While there do exist manufacturer-owned retailers, most retailers carry multiple brands. Accordingly, the individual dispenser runs business with a number of manufacturers, usually in the range of 3-5. The interaction is rather complicated, involving much more the simple ordering and delivery of predefined products. The dispenser performs a series of examinations to offer the optimal model and features for the customer. Based on these examinations, the dispenser orders the custom-designed instrument with the manufacturer. A week later he receives the instrument by mail and fits it to the customer.

These procedures are cumbersome in many respects: The manufacturer frequently receives flawed order-forms, not the least because all manufacturers use different forms. In case the manufacturer discovers the flaws must call back the dispenser. The dispenser likewise has problems with these procedures. He cannot track his orders, has no backlog of orders etc. So obviously, there is room for some kind of EDI. The big problem is who to introduce it?

The manufacturer may well offer dispensers access to a distinct electronic ordering system. But as the dispenser deals with several manufacturers, the prospect of running 3-5 different, internet-based ordering systems is not attractive. This is even more so if these systems cannot feed information into a store-based information system including customer files, billing capacity etc. The individual dispenser, on the other hand, has no incentive to develop a system and has probably no means of getting access to manufacturer information.

There are at least three possible solution to this deadlock: One is an independent supplier, one is a dispenser-based solution, and one is a manufacturer-based solution. Although there are examples of close manufacturer-cooperation, for example on fitting software, it doesn't seem likely that manufacturers get together in this area. An independent supplier may have a chance, but lacks the bargaining power towards the manufacturers to get them to agree on standardized interfaces.[5] The dispenser-based solution seem more promising. One emergent possibility is a chain-based solution: The Portland, OR, based chain Sonus has developed a generic order-form to be used by the individual stores and processed by the headquarter of the chain before it reaches the manufacturer. This system improves logistics, creating centralized customer-files, enables tracking of orders and reduces flawed orders.

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5 There is at least one (Danish) software company producing a dispenser-internal information system. It still, however, lacks the communication modul.

This system has had an unintended consequence: Since autonomous dispensers clearly could benefit from such a system, Sonus has experienced a certain interest from such dispensers to join the system – without joining the chain. So far Sonus has accepted this, expecting an important, positive side-effect: As independent dispensers order via Sonus, the volume that Sonus commands increases, which naturally increases fitting experience – and bargaining power towards manufacturers. The prospect of this development therefore may well be a consolidation of the dispensing business.

Conclusion

This brief assessment of the potentials of e-commerce in the hearing instrument industry points at a number of potential changes:

- Web-based marketing may enlarge the market
- Transparency may increase, leading to tougher price competition
- Independent retailers may suffer from demands for higher quality of service, leading to consolidation in retailing and/or less binding cooperation between retailers
- Scale economies in EDI and information management systems may lead to the same outcome
- Technological change may be directed towards product concepts that facilitate web-based trade. Only with such products, retailers may be disintermediated

It should not be forgotten, though, that the very nature of the product as very customized, probably will not allow rapid changes to take place in any near future.

The Hearing Instrument Industry:

Rapid concentration in the second half of the 1990's:

Oticon (DK) buys Bernafon (CH) in 1996 and Phonic Ear (US) (1997)
ReSound (US) buys Viennatone (AUT) (1994) and 3M Hearing Health (Sonar) (US) (1994)
Starkey (US) buys Qualitone (US) (1996) and MicroTech (US) (1999)
Beltone (US) buys Philips (NL) (1999)
GN Danavox (DK) buys ReSound (1999) to form GN ReSound
Siemens' subsidiary A&M (UK) buys Electone (US) (1999)
American companies Unitron, Lori Medical Lab and Argosy merge (2000)
GN ReSound buys Beltone (2000)

Current structure: 5 leaders (10-20 pct. market share each)

Siemens
GN ReSound
Starkey
Oticon
Widex