Futures 50 (2013) 86–93

Contents lists available at SciVerse ScienceDirect

Futures

journal homepage: www.elsevier.com/locate/futures

Auditory Crescendo

Geoff Nelder *

Geoff Nelder Imagination Factory, United Kingdom

ARTICLE INFO

Article history:
Available online 19 April 2013

Keywords:
Science Fiction prototypes
Commercial markets
Military
Innovation
Hearing aids
New technologies

ABSTRACT

This prototype explores the impact of radical disruptive innovation on hearing aid product capabilities. New markets created through the successful commercialization of military technology ('spin-off') goods have a long and profitable history. For instance, the Internet, GPS, lithium ion batteries and wireless communication tools. But although a product works in a military environment there are significant challenges in bringing it successfully to a commercial marketplace. Military-industrial capabilities are focused on having technological superiority over the enemy while cost and price considerations have a much more important role in commercial settings. Successful diversification of radical military innovations into the commercial sphere is difficult to predict, as this involves the development of new concepts with no current examples. Further they also often potentially completely change the marketplace of an industry (such as the case of the music and newspaper industries). This type of innovation frequently involves bringing in technology from one field into another (civil diversification). The prototype also explores the social and emotional consequences of the super-enhanced hearing aid innovation.

1. Introduction

Hearing aids have advanced significantly over the past decade, primarily due to the maturing of digital technology [1]. The next decade should see an even greater number of innovations to hearing aid technology, and this prototype attempts to explore social and economic dimensions from the development of a future 'military super-enhanced hearing aid.' Industry innovations occur in either incremental steps or in radical changes. The incremental innovations are easier to predict because they involve natural progressions of existing technology. However, here the focus is on radical innovation and its uncertain consequences [2].

Hearing aids today have many automatic features: turning directionality and noise reduction on and off, classifying the environment that the user is in (e.g., car, noisy restaurant, quiet office) and making adjustments to the hearing aid settings. This automation will continue to evolve, but learning will also be added to hearing aids, making them "intelligent" [3]. Current adaptive algorithms in hearing aids should not be classified as intelligent because they lack learning, which is the ability to improve behavior over time in response to sensor information [4]. Techniques such as neural networks, fuzzy logic and genetic algorithms have been researched extensively in academia for use in systems that learn behavior and alter how they work in an optimal way, and we should expect their emergence into the hearing aid industry. One application for intelligent systems is to assist with individualized fittings. The proper fitting of the parameters of a hearing aid by the audiologist or hearing instrument specialist to the needs of the hearing aid wearer is critical to the success of the hearing aid.

* Tel.: +44 1244677989.
E-mail address: geoffnelder@yahoo.com.
URL: http://geoffnelder.com/

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http://dx.doi.org/10.1016/j.futures.2013.03.010

Durant et al. implemented a genetic algorithm that adjusted the parameters of a feedback canceller in a hearing aid such that the feedback canceller improved its performance over time [5]. The genetic algorithm required the wearer to assess the sound quality of the hearing aid with different parameter settings, and the algorithm used the listener's responses to continually adjust and improve the feedback canceller and the resulting sound quality. One can imagine that this approach could be applied to many aspects of hearing aid use. Such a system would have to be designed to be easy to use and to ensure that the hearing aid continues to improve as it adapts rather than mistakenly get worse [6].

To add credence to some of the concepts in this story it is noted that a preliminary design of implantable hearing-aid sensors is referred to in [7]. While researchers at Imperial College, London have completed in-depth analysis into wearable sensor devices that are placed in the inner ear [8].

Abner hoped safety would come in the wide plains of Kansas. Open miles of no one. At least the noises there were two-dimensional, unlike in the military hospital. No voices wheedled into his wrecked ears from above, or from below like when he was imprisoned on the eleventh floor of the Silverstein Institute of Audiology in Florida.

A plant with tiny red flowers caught his eye. He'd been a sucker for wild plants even back when nerd accusations hurt him. He'd left high school and joined up for Iraq only to be roadside bombed. He squatted to examine the Scarlet Pimpernel, otherwise known as The Poor Man's Weatherglass. The open petals meant it was going to stay dry. Good to know; he couldn't take the deafening noise of rain any more. He teased it with a fingernail while enjoying the earthy aroma from a nearby molehill. Resisting the temptation to pick the lonely blossom, he stood. Arrgh, here came a voice. There must be a nearby cabin. He stuck his index fingers in his ears to bring a temporary respite.

He ran up the steps to the trailer home – a temporary sanctuary – but then had to unplug his right ear so he could open the jammed door.

'Sit on him, Enrico. Now dislocate all his fingers.' This time the heavy Kansas female voice raised a quarter octave from her demands an hour ago. Four miles away. The sound pierced his brain; not painfully but it intruded, swamping and numbing his own thought processes.

'He's jus' airin' his lungs with that cussing. Go for that finger. Go on, why yer waiting?'

If they were much closer, their voices would hurt; vibrate his brain to migraine jelly. Abner struggled to open the jammed door and risked using both hands.

'I will then.' This time, masculine. 'But not because you say so.' Californian accent, in his fifties, chewing gum, so the inside of his mouth made wet noises.

A shriek from a younger man but thankfully Abner had entered his trailer home and his fingers were back in place. He sank to the floor with his back to the door, fingers worming their way deeper into his ears. The thin door would make little difference, nor the bare aluminium walls. He could still hear muffled cries. He'd have to use his earplugs.

He'd a new worry hearing that threat, and maybe a beating. He should call the authorities but he couldn't, rather wouldn't – he needed more days of freedom.

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After the first round of hearing tests he'd been summoned for another consultation.

Different audiologist too. Susan McBain. Charming Scottish woman, who seemed as tall and as thin as a street lamp – with a red fringed lampshade. Her lips moved.

Damn, he hadn't switched his aids on. He'd have heard better if they weren't acting as ear plugs when they were off. He'd arrived by taxi and had refused to listen to the driver's presidential-election-blathering.

> 'I'm sorry. Repeat?'
> 'Abner Skelton? At twenty-six you are younger than normal to have to wear external hearing aids. We'd like to use an experimental cochlear implant. . .'

He shut out input – a feat he'd practised years before his ears lost efficiency. The implant concept needed to inveigle its way through to be considered. He'd never had surgery. He quivered at the idea of being lacerated even for his own good. The blast had rattled him in the humvee but his body had no visible damage. He put his right hand up to finger his aid. Felt the smooth plastic, which enabled an instant smile, then off again. Initially he wouldn't wear his aids, especially in public – all those stares. But in time it'd become part of him. As normal as teeth fillings and spectacles. His fingers caressed and inadvertently upped the volume.

> '. . . Clinton has one. Are you with me, Mr Skelton?'
> 'Course. In each ear?'
> 'Who, you or the former president? Doesn't matter. Yes to either. Your auditory tests need to be more rigorous than before. Come through to the lab next door. There's forms to sign too.'
> 'Aren't there always?'
> 'You'll need your hair off.'
> Instinctively, he stroked his spiky hair. 'I bet Bill didn't.'
> 'Bill? Oh, his was simpler and cosmetically expensive. Why worry? That cut is a number two isn't it?'
> 'Four.'
> 'It will be four again soon, but with the advantage of your ears not needing those outdated contraptions and with enhanced facilities. You just wait.'