The Future of Voice First Technology and Older Adults

Innovation to Boost Quality of Life

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EXECUTIVE SUMMARY

For the past decade, software designers and developers have been driven by a "mobile first" mindset. As people spent less time using desktop browsers and more time on their smartphones, application providers focused on building mobile apps first – and desktop applications second. A new trend has emerged, pushing leading edge software developers to shift from mobile first to "voice first." Voice First refers to applications that people control primarily by speaking, leveraging the latest developments in Natural Language Processing (NLP).

In this report, we use the term Voice First to identify this emerging category of voice-controlled devices and the applications they support. Older adults, caregivers, and service providers quickly recognize the power of voice first and the huge advantages that voice-driven applications have over both desktop and mobile versions. While the category has obvious benefits for those with visual and motor difficulties, its power to improve the lives of all older adults should not be underestimated. This report discusses the opportunities, both in 2018 and moving forward.

"Let's remember, it's just voice – and that works perfectly for seniors."
– David Inns, CEO of GreatCall

INTRODUCTION

Many technologies designed to improve the lives of consumers over the past several decades have emerged and disappeared, bypassing older adults or being adopted late in the market's lifecycle. The evolution of Natural Language Processing (NLP), combined with progress in Artificial Intelligence (AI) and machine learning are poised to break this pattern. These innovations and their future potential are explored in this (and future) reports. This research has shown why the emergence of Voice First technology is a remarkable opportunity for seniors and those that provide them with care and services.

WHO SHOULD READ THIS REPORT?

- Investors and funds that focus on older adults
- Senior living organizations and professional home and health care companies
- Vendors within or considering entry into the market for Voice First technologies
- Technology platform providers
- Telecommunication carriers
- Social services and non-profits with focus on older adults

ACKNOWLEDGEMENTS

HYPE, DISRUPTION, THEN ADOPTION
But Technology Change Bypasses Older Adults

As technology change accelerates, older adults miss out. The cycle of technology adoption is best mapped with Gartner's Hype Cycle, which was envisioned for enterprises, but applies to markets of older adults and the people who serve them.[1] As technology evolves, the plateau of productivity eludes them, especially if they adopt late, only to encounter the next disruptive wave. Consider the adoption cycles and challenges limiting productive use of the technology before the next wave (see **Figure 1**):
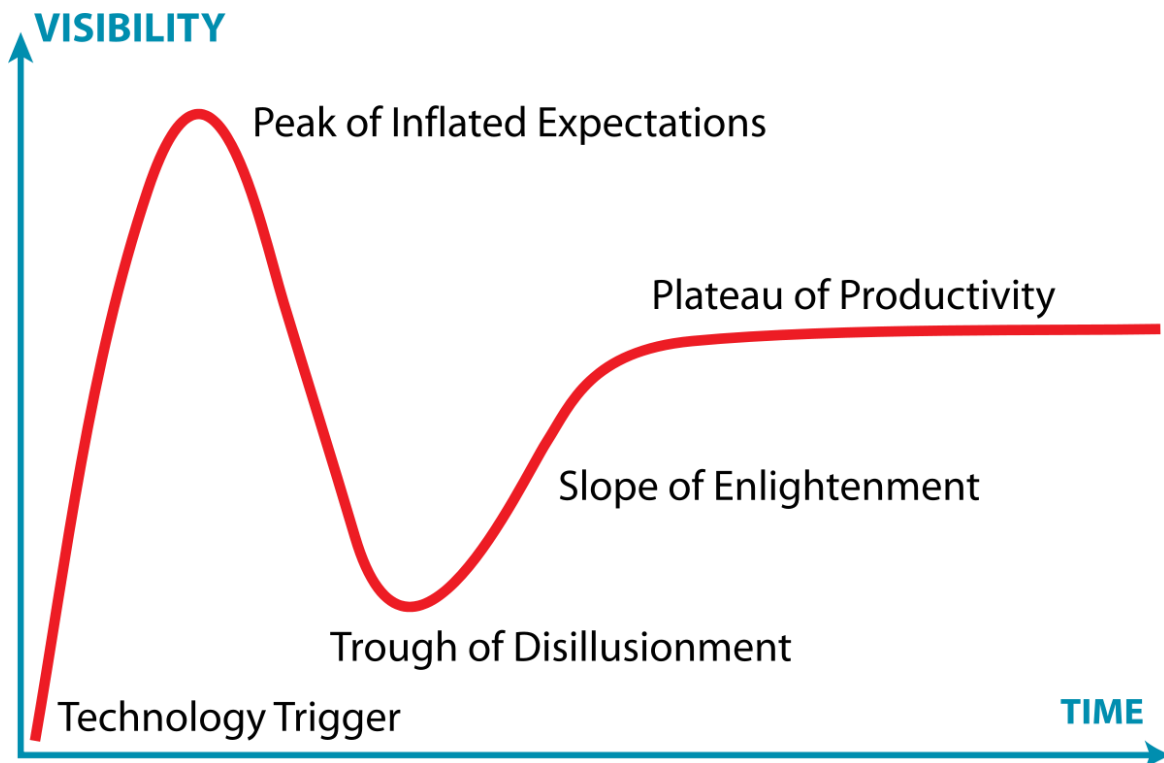

Figure **1** The Gartner Hype Cycle: First the hype, then disappointment

- **Speedier access - internet, browser, broadband.** Adoption on the Internet for older adults was slow. Consider the Internet adoption curve from 2000-2015 for the 65+.[2] Amazon and eBay launched in 1995, but their uptake depended on the pace of Internet adoption, which began to pick up around 2004 – likely because web browsers did not begin to evolve until 2003. Meanwhile, access to the Internet was dial-up for the first years until the widespread availability of high speed (broadband) access (see **Figure 2**).[3]

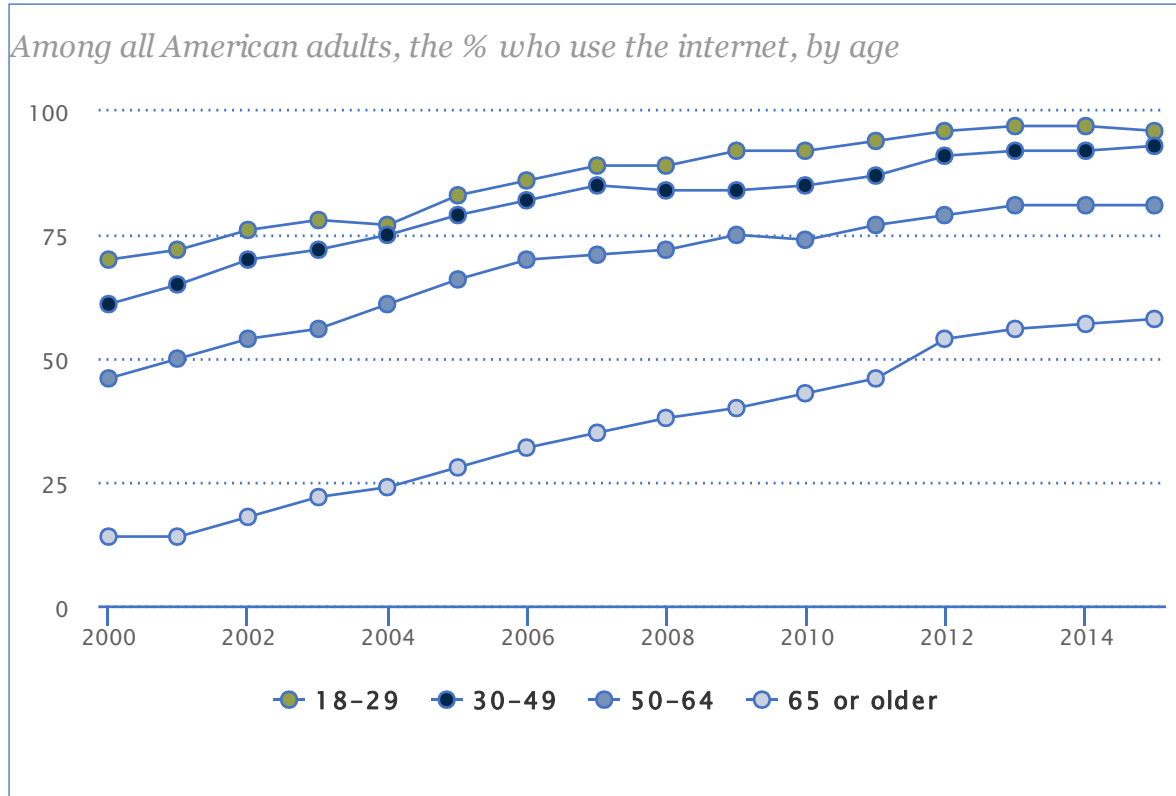Among all American adults, the % who use the internet, by age

Figure 2 Internet and Broadband Adoption   Source: Pew Research Center

- **More personal – PC/Mac, smartphone, tablet.** Personal devices had an even more accelerated pace of change over the same time period. PC and Mac adoption in the 80's and 90's was gradual; tablets and smartphones offered greater mobility with shorter life cycles. While tablets like iPads have appealed to seniors, smartphones have been more confounding and subject to frequent obsolescence. The result? Many older adults have not kept up with the devices' smaller size and poorer user experience (see **Figure 3**).

Roughly four-in-ten seniors are smartphone owners

% of U.S. adults ages 65 and older who say they own the following ...

	Cellphone of any kind	Smartphone
Total 65+	80	42
Age		
65-69	95	59
70-74	93	49
75-79	63	31
80+	58	17
Education		
HS or less	75	27
Some college	83	45
College+	87	65
Household income		
<$30K	73	27
$30K-<$50K	82	32
$50K-<$75K	86	53
$75K+	97	81
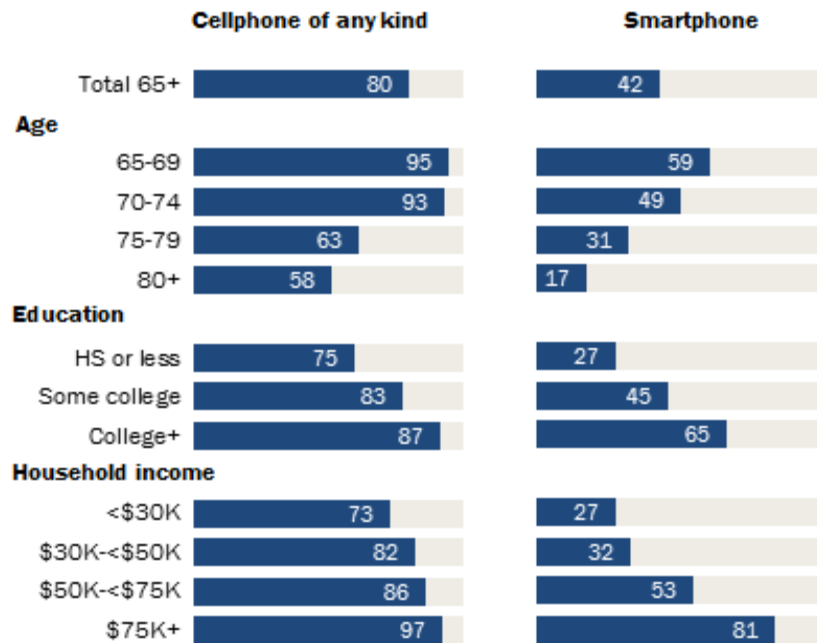
Source: Survey conducted Sept. 29-Nov. 6, 2016.
"Tech Adoption Climbs Among Older Adults"

PEW RESEARCH CENTER

Figure 3 Smartphone ownership by age

- **Telephones, IVR, texting, TV – the technology wave of worse.** More than half of American households are dropping their landlines in favor of cellphone-only.[4] While carriers are in favor due to lower maintenance costs, regulators worry that in an emergency, a caller's location is difficult to verify.[5] Interactive Voice Response (IVR) – 'press 9 to talk to an agent'– has become one of the most people-hostile experiences (other than TV knobs and remote controls) for people of all ages who just want to speak to an agent who understands their request.

For older adults, rapid tech change can be overwhelming

Social isolation has worsened for older and/or less tech-aware segments. Why? Product replacements are more difficult to use, whether it is device screen sensitivity, screen size, the continuous need for OS upgrades. The pace of software updates is accelerating, with many of them security-related as hacker threats grow. Older adults and those who care about them examine this landscape and find the following challenges (see **Figure 4**) such as:

- **Cost is too high versus the benefit of technology improvement.** Most people replace their smartphones after 2-3 years – even though the device's life is more like 4.7 years for

smartphones and feature phones.[6] Consider that 24 million clamshell (flip) phones were sold in 2016, 2 million more than in 2015. While seniors make up a big percentage of users, others like the low price and superior telephone call form factor, plus the long battery life – in contrast to the $800+ smartphone, need for a headset, and daily, if not more frequent, charging requirement.

- **Mobile apps require updates and costly retraining.** Smartphones have spawned more than 2 million apps for each of Android and iOS.[7] App vendors frequently update them, sometimes to add features, but also to fix bugs and close security holes.[8] Optional updates are often ignored, which can result in slower performance or falling so out of date with fixes that an actual update is not feasible. Or as with older iPads, the vendor declares the device itself to be obsolete.[9]

- **Tech-enabled threats fuel fear and more updates.** Tracking malware has become a business unto itself. One-fifth of devices had security breaches and 1.5 million new incidents were detected within just one quarter in 2017. In fact, a quarter of those device owners did not even know that their device had been under attack.[10] Often the malware is embedded within ads that are inside publications which older adults trust – an email attachment inadvertently sent by someone they know.[11]

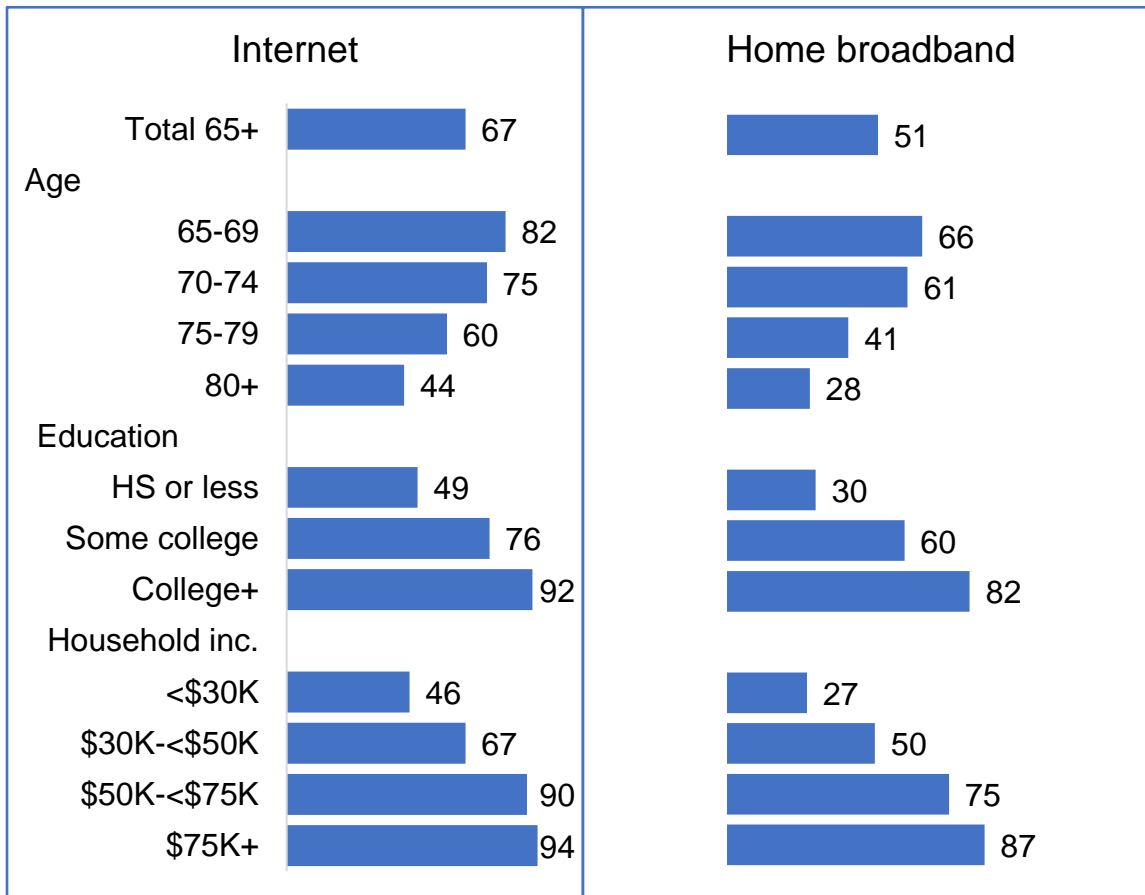|	Internet	Home broadband
Total 65+	67	51
Age		
65-69	82	66
70-74	75	61
75-79	60	41
80+	44	28
Education		
HS or less	49	30
Some college	76	60
College+	92	82
Household inc.		
<$30K	46	27
$30K-<$50K	67	50
$50K-<$75K	90	75
$75K+	94	87

Figure 4 Internet and broadband percent adoption varies among seniors   Source: Pew

VOICE FIRST AND VOICE USER INTERFACE (VUI) EMERGE

The groundswell of interest in Voice First technology originated with Amazon's Echo line in 2014, bringing a burgeoning collection of smart speakers in multiple sizes and shapes. In 2016 Google Home was launched and Apple HomePod was released in 2018. Smart speakers were a novelty for Amazon Prime users initially, but devices and the related Alexa voice assistant fueled a wave of competition among assistants – offerings from Google (Google Assistant), Samsung (Bixby), Microsoft (Cortana). In 2017, Amazon began to shower the market with cheaper devices in new, even visual (Amazon Show) form factors, updating the technology and features from its cloud infrastructure, helping the product line to grow to an installed base of at least 22 million units by the end of 2017.

- **Behold – a product category and interface**. Voice First has become an industry term for technology focused initially or sometimes only on spoken commands.[12] This interaction method was dubbed a **Voice User Interface** (or VUI) and marked a significant step change in how content and applications are consumed (see **Figure 5**).[13]
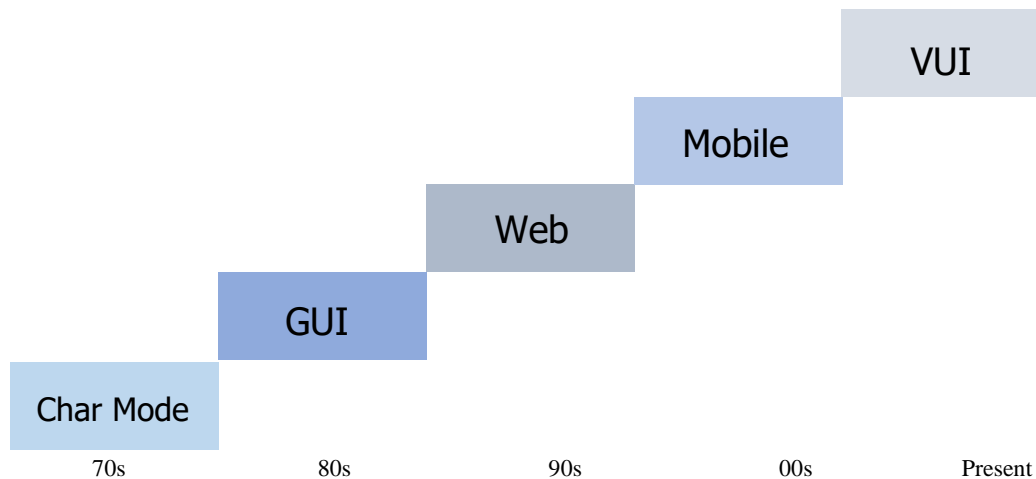

				VUI
			Mobile	
		Web		
	GUI			
Char Mode				
70s	80s	90s	00s	Present

Figure 5 Enter the Voice User Interface

- **Sheer volume of sales spark competitors.** By the end of 2017, millions of Echo-powered devices, from alarm clocks to speakers and beyond, were in the market. And for the first time in several years, a noisy war between companies was born – Google vs. Amazon, with Samsung, Microsoft, and Apple attacking from all sides. In the spring of 2017, interest in Digital Voice Assistants had grown, especially among millennials (see **Figure 6a, 6b**). [14]

"This is a massive change: we will be liberated from keyboards, touch screens and apps that keep us glued to our smartphones and laptops." – Daniel Ferraz, **OnGuardian**

US Smart Speaker Installed Base - 2016 to 2020

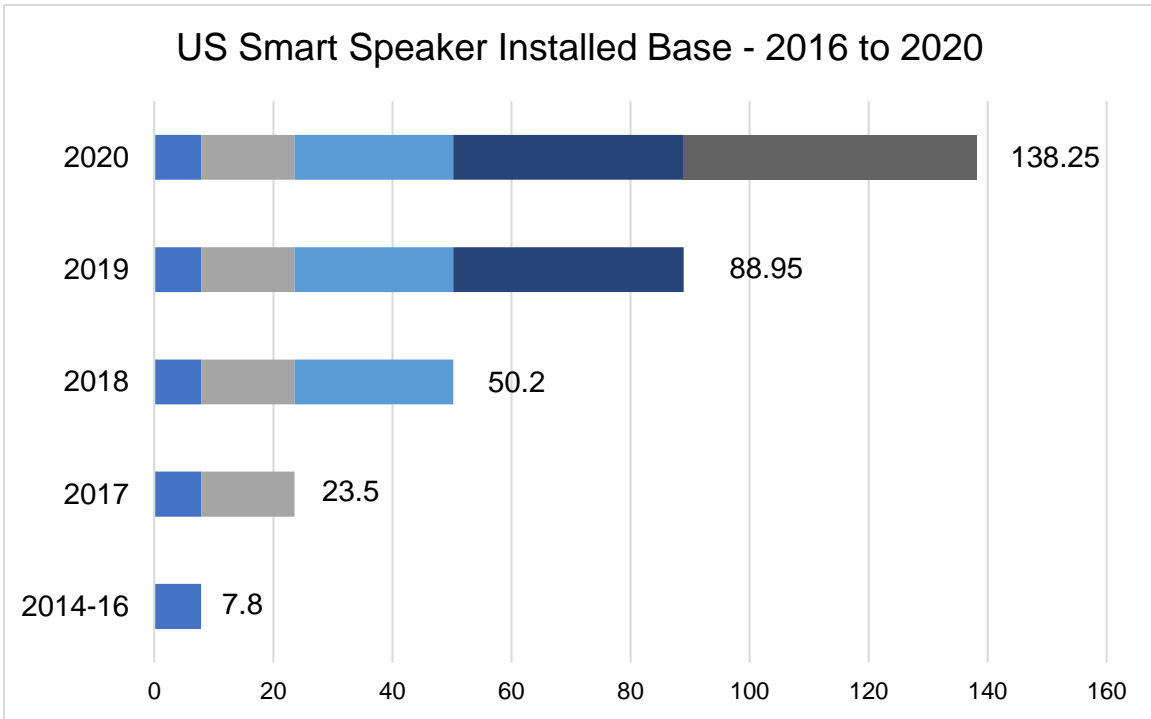| Year	Value
2020	138.25
2019	88.95
2018	50.2
2017	23.5
2014-16	7.8

Figure 6a Total Number of Smart Speakers (millions)

Source: CIRP, VoiceLabs, Statistica, Edison Research, Voicebot.ai

US Voice-Enabled Digital Assistant Users, by Generation, 2016-2019 (millions)

Year	Millennials	Gen X	Baby Boomers
2016	23.3	13.4	8.6
2017	29.9	15.6	9.7
2018	35.8	16.7	9.9
2019	39.3	17.2	10.1
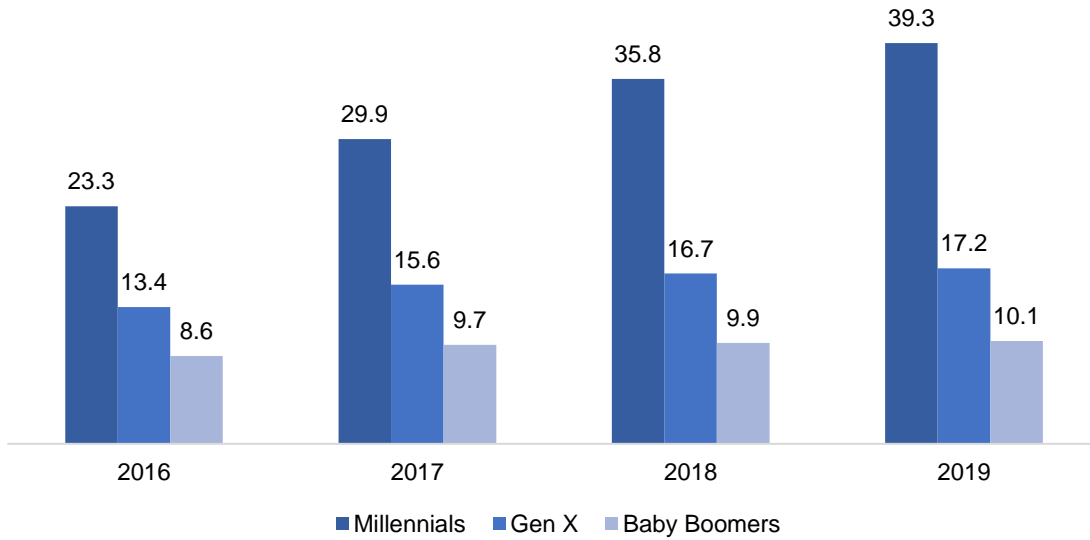
Figure 6b Future Growth in Voice Technology

Source: eMarketer, April 2017

- **Platform wars have been declared.** Echo/Alexa, Google Home, Samsung Bixby, Apple, and Microsoft Cortana compete, with the early lead from Alexa-enabled device access and an aggressive push from Google. Google Assistant and its Google Home device line (Mini and Max) were released in October of 2017 with the Google Assistant as the Voice First and home control alternative to Alexa (see **Figure 7**).[15] For Amazon, bringing the price point down to $30 for the Echo Dot enabled Amazon penetration to grow to estimates (without corroboration from Amazon) of 22 million in the US and up to 40 million worldwide.[16]

- **Voice assistants faced off at CES 2018.** Half of Americans surveyed by Pew in May 2017 indicated that they are users of Digital Voice Assistants.[17] Though the report indicated that this was mostly on their phone, the cited reasons to use also maps to the needs of older adults, including the 'ability to allow them to use the device without their hands' and that 'spoken language feels more natural than typing' (see **Figure 8**). Meanwhile, at CES 2018 in January, Amazon's Alexa and Google Assistant were confronted with each other and, according to many observers, 'made CES relevant again.'[18]

"Voice assistants can empower people to attempt something that they have lost in a way that may seem magical." – Ginna Baik, CDW Healthcare

- **Voice interactions edge into every interaction for a willing user.** By November 2017, the forecast was for 55% of US households by 2022 to have a voice-enabled smart speaker.[19] Voice assistants and smart speakers are helping to morph our expectations. Today we have become comfortable with spoken requests/answers for turn-by-turn directions and Interactive Voice Response (IVR) systems. By the end of 2017, voice interaction usage spanned car, home, phones, and hotels.[20] Voice interactions are migrating into each vertical market at an accelerating pace.

*"Our company is developing a Voice First Concierge Service for senior housing – for example, to request services or inform about events." – Caroline Stroud, Managing Director, Resident Engagement, **Senior Portal***

What is Natural Language Processing?

The ability of a computer program to understand human language as it is spoken. NLP is a component of artificial intelligence

What is Artificial Intelligence?

"The ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal."

(Source: Investopedia)

What is Voice First?

Speech-enabled interactions designed for delivery through voice-activated devices and software, built on Natural Language Processing and Artificial Intelligence.

How Big Are the "Next Big Things" in Tech?
Est. revenue, sales of emerging tech products in the US, 2018

$15.9b +14%
$6.4b +1%
$4.5b +34%
$3.8b +93%
$1.2b +18%
$1.2b +17%

4K UHD TVs Wearables Smart Home Smart Speakers VR Drones

Source:
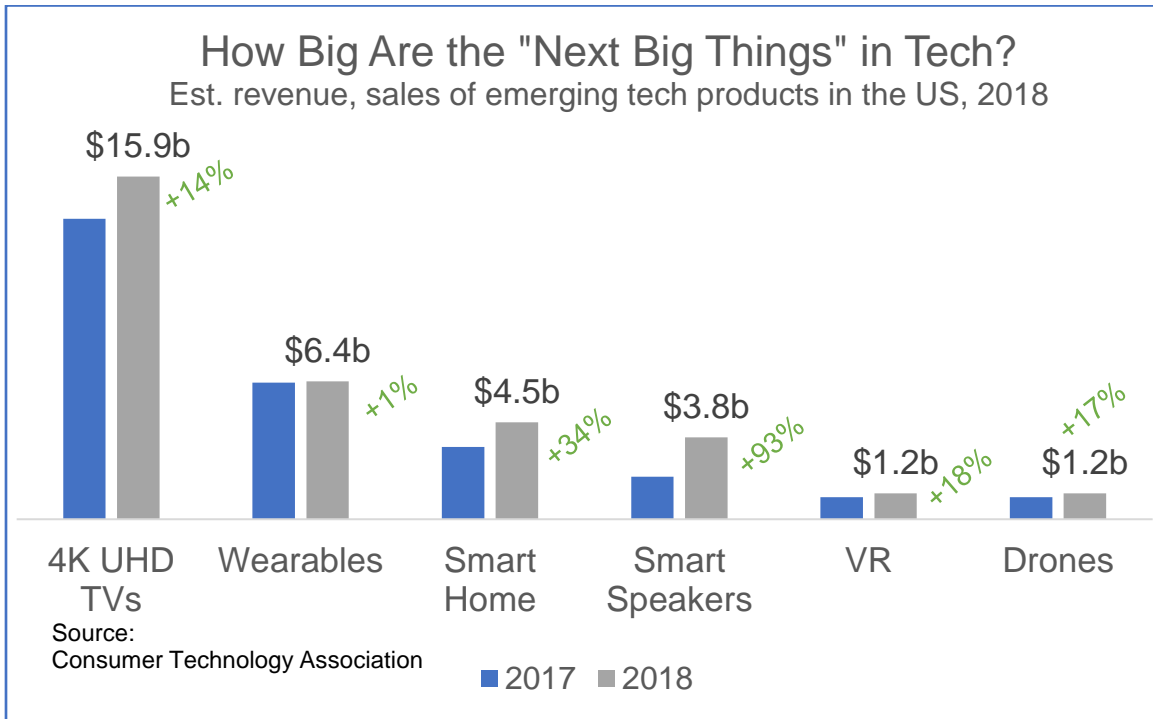Consumer Technology Association

■ 2017 ■ 2018

Figure 7 Are Smart Speakers a separate market from the Smart Home?

"2018 is the Year of Voice First initiatives. Initiatives will be difficult or rudimentary. In 2019, enterprises will narrow their choices. But 2020 and beyond will offer Voice First design for digital experiences, a shift to conversational experiences and tooling with enabling platforms." – Nate Treloar, President and CEO, **Orbita**
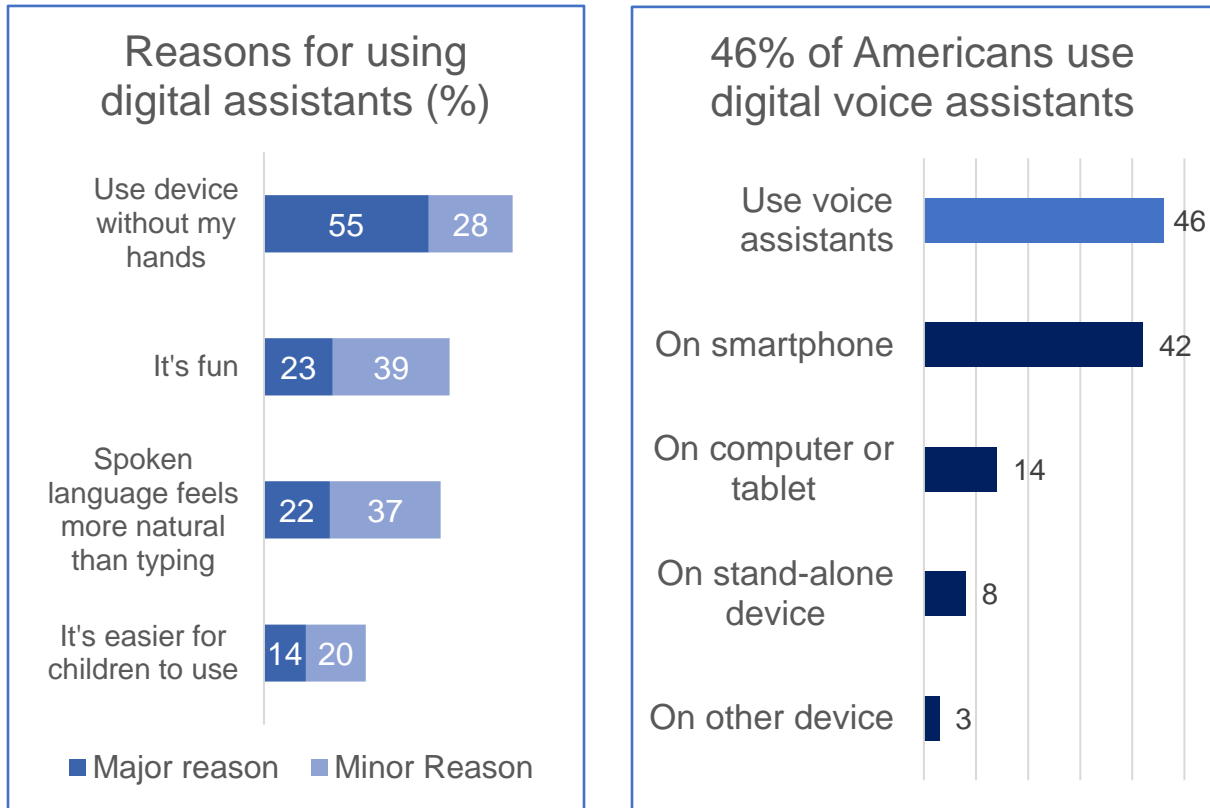
Figure 8 Use of Digital Voice Assistants   Source: Pew Research Center

"Voice technology is intuitive for people of all ages. In healthcare, voice will be used to deliver content tailored to the patient and their experience." –AARP – Sami Hassenyah, Chief Digital Officer, **AARP**

- **Senior housing groups consider adoption.** Late adoption and disappointment have characterized the senior housing industry's relationship with technology.[21] But some organizations see the opportunity with voice first technologies – and they are becoming pioneers in a journey that others will emulate. For example: in December 2017, the Front Porch Center for Innovation and Well-Being published a report about its success using Alexa in a California independent living community.[22] And Benchmark Senior Living's experience with voice technology was documented in Senior Housing News that same month.[23] Meanwhile, Intuition Robotics has begun piloting an 'active aging voice-activated companion' called ElliQ that is designed to notice the emotional status and behavior of an older adult.

    "Perhaps an offering like ElliQ will see that you have been sitting for a while and say that you should consider taking a walk." – Jody Holtzman, **Longevity Venture Advisors, LLC**

VOICE FIRST TODAY – FOR SENIORS, IT'S A BEGINNING
What you say should help get what you need

What makes Voice First special for older adults? The differences between Voice First technology and prior technologies apply to all users.[24] For seniors, it's a leap forward. What has inspired senior communities to start their pilots and programs? They see that Voice First is:

- **Easy: Download versions and upgrades are unnecessary.** Patch Tuesday for Microsoft users or iOS update reminders are likely not part of the older adult user experience. But the Amazon Echo Show speaks what needs to happen next after the device is powered on, presenting suggestions and tips in large type. A caveat, however – as the Front Porch users discovered, without any prior technology exposure, some training is required, especially to use features to control lights and room temperature.

- **Cheap: Device price war put offering within reach – but is there Wi-Fi?** The Echo Dot and the Google Home Mini are racing for the bottom ($29-50) of Voice First device price ranges. But they work just as well when spoken to as the largest and most expensive variant. However, Wi-Fi connectivity is a prerequisite – and not a given in many senior communities or private homes.

- **Useful: Content can both surprise and impress.** Information behind these devices is a constant surprise and delighter. Jokes and weather, but also: streaming music, audio stories and news. For the tech-phobic, these interactions represent a disruptive change and an experiential upgrade. Cooking timers, alarms and reminders – "It's 4:00, Did you take your medication?" are part of the basic features. Note these are not interactions, and other than 'Stop', do not yet address what happens if you didn't comply.

- **Smart: Last week's functionality can be forgotten.** While not the first cloud-based capability, voice first technologies' update cycles craft a new user experience. The devices and software increasingly know who you are and can tell you what's new; remind how functions work; and can be queried and/or trained repeatedly about the same feature – simply by speaking a question. For example, "Alexa, what do you know?" Or "Hey Google, how do I play music?"

- **Connected: Home automation just works.** For the Front Porch pilot participants, the home automation integration was itself a surprising benefit – learning to control the thermostat, connected light bulbs and outdoor camera. The pilot participants marveled that they could turn on lights, change the room temperature and see who was at the door – all without leaving their chairs.

"Voice First technology empowers older adults to access valuable services but more importantly, helps them be engaged participants in our society." – Mary Furlong, CEO, **Mary Furlong & Associates**

The Future of Voice First and Older Adults

With a new set of hardware and a category that bears no resemblance to what preceded it, all consumers need a bit of time and instruction – some of it coming directly from a connected device to figure out what to do. Misconceptions abound – for the Echo, that includes whether a smart phone is required to get started (No) and whether all voice recordings can be deleted (Yes).

- **Getting started – that needs work.** The obvious with each of the Voice First technologies is they are not simple or 'out-of-the-box' for the uninitiated. The Echo Show comes with a small cardboard insert of the first steps for getting started, but at a minimum, the user must first have an Amazon account (Prime not required). The Echo and Google Home list of instructions are online as well – account and app download requirements as of February 2018 are in **Appendix 3.** One future opportunity may be to create 'Alexa in a Box' or a 'Google Home in a Box' kit for senior living firms, emulating the steps undertaken by Front Porch or Benchmark Senior Living.

"Organizations can use voice technology for older adults to enable and honor their independence – but they must own the deployment and follow up with training and support."
– Davis Park, **Front Porch**

- **Voice First – but not voice only?** Some assert that the voice interface is the more natural, but that may depend on how smart the response is to a question or command – otherwise Siri would have done a better job than 11% penetration at engaging Apple users.[25] When the setting does not lend itself to speaking, touching tablets and phones (or an Echo Show-like offering) with the sound turned off can become the second choice.

"Voice control is a growing technology that uses a very natural way to interact. It is part of a larger accessible ecosystem that enables use for people of all ages and abilities. These technologies are constantly improving which allows them to adapt to you, including if you have a soft voice or other limitations." – Steve Ewell, **CTA Foundation**

- **Reactive AND proactive – are you okay?** Should the device or software be proactive, rather than only responding to a wake word, or to continue a personalized conversation in the direction the 'conversation' is headed? For example, a response to the question "What time is dinner?" could note the time and suggest personal musical favorites to play. Even more significant is the possibility of proactive speech/conversation about healthcare in the home. As of early 2018, LifePod Solutions, in pilot with Commonwealth Care Alliance, was unique – it can be configured to initiate speech without a wakeup word, including "It's 4:00, did you take your Lasix?"

"In general, the ability to talk remains highly effective for all aging populations at a time when physical movement, eyesight, and hearing often decline." – John Loughnane, Chief of Innovation, **Commonwealth Care Alliance**

- **Supporting Caregivers – with a view and sound of the care recipient.** Caregivers have long felt left out of the benefits of 'caregiving technology.' Surveyed repeatedly, they were doubtful about its utility in 2011 in a report by the National Alliance for Caregiving.[26] They again expressed doubt about technology's role in assisting them in 2017. However, they found one aspect of voice-enabled PERS/medical alert use intriguing: "Users found it helpful to hear their loved one's voice in emergencies." [27] A Voice First medical alert device could bring the sound of a loved one's voice and perhaps visual image to the caregiver, boosting confidence that all is okay.[28]

"With a Voice First wearable, it is possible to learn an individual's lifestyle and provide suggestions based on utilization and behavior, offering comfort for independent but vulnerable populations." – Jean Anne Booth, Founder and CEO, **UnaliWear**

- **Mitigating the social isolation of older adults.** Studies have repeatedly shown that lonely people need to talk to someone.[29] In recent years, social isolation has been linked in studies to poorer health outcomes, increasing the risk of heart disease by 29% and stroke by 32%.[30] But perhaps what they need is to speak to a Voice First technology and hear a response. AARP Foundation is conducting a pilot determine use in reducing isolation and improving health outcomes: "People feel less lonely talking to Alexa."[31]

"In the future, voice-enabled technology will assist with companionship. When my grandmother hears our voices, she is a different person." – Ted Fischer, VP Business Development, **Hasbro's Joy For All**

- **Enabling those with disabilities.** Voice First technology has been shown in multiple examples to be a low-cost and transformative interface for those with disabilities (see **Appendix 1**). For example, it may serve as a low-cost replacement or supplement to assistive technologies which have traditionally been low-volume and expensive to manufacture. [32] Consider the $5000 screen reader or an Environmental Control Unit (ECU) to control devices in the home that can run to thousands of dollars.[33]

"By acting as a compensating intelligent assistant, Natural Language Processing should provide a new, intelligent kind of hearing aid. Those with vision issues can have the AI read to them and execute transactions on their behalf." – Amy Stapleton, Co-Founder, **Tellables**

- **Supporting health care service delivery.** The health and elder care industries see the opportunity with voice-enabled technologies. Perhaps the care recipient speaks to Alexa, but the answer is returned from Watson.[34] Or the patient interacts with an avatar that queries them in a dialogue about their health. Some Voice First technologies like LifePod can use the Alexa or Google interface – others are robots (like **ElliQ** and **Jibo**) or they are online avatars, like **Sensely's** Molly, to query a patient about health status.

"Older consumers can feel overwhelmed and stressed with information and choices. By acting as a companion, an advocate, and a trusted advisor, voice assistants can help maximize cognitive functioning and improve well-being." – Patrick Hafford VP, **Optum**

Overcoming limitations

For Voice First, there are multiple barriers to broader senior adoption. As of January 2018, interviewees agreed that the Voice First market was barely in its first year – and that the category has great potential for enabling older adults to make greater use of technology in their lives. But limitations are significant, and interviewees noted that they may be difficult to overcome in the near term. These include:

- **Availability of Wi-Fi, both at home and in Senior Living, may not be a given.** Voice first technology access requires high speed internet (broadband) connections. And the good news is that more than 80% of Americans now have home broadband according to Pew Research.[35] But that statistic masks the detail – that half of seniors do not have broadband at home and a third of seniors do not use the Internet at all.[36] This may be particularly notable in senior-centric settings like skilled nursing facilities and in many assisted living communities. As a result, speaking to a technology in those settings, whether for staff or residents, may not be possible.

"I have not seen NLP used effectively in Long Term Care settings – the Wi-Fi may not work well – and integration of voice-created data (even dictated notes) into the EHR is ineffective." – Erik Pupo, Managing Director, **Accenture Health Client Service Group**

- **Language and voice frailty may limit access.** As of December, Amazon has offered the English speaking (or German/Japanese) Echo line in 80 new markets – which has some expecting localization for those markets soon.[37] Google Assistant and Siri have a much broader language footprint, which may help the sales of Google Home and Apple HomePod offerings. Yet in all cases, for seniors that are too frail to speak loudly enough to the device – or those whose speech is labored may become frustrated.

- **Privacy and security concerns may hamper adoption.** Some interviewees expressed concern about always-listening devices with microphones that must be 'turned off' to terminate listening to and misunderstanding of spoken phrases. With the Amazon devices, it is now possible to delete stored voice recordings, one at a time or all.[38] With Apple's HomePod the user can tell the device to stop listening.[39] Moving forward, all these devices must be able to switch themselves off, either on a set time schedule or on command. And all devices and software should have settings and features that prevent inadvertent or faked shopping or identity theft.

- **Lack of integration across devices and platforms hampers sharing of data.** Today's hardware and software environments are a cacophony of incompatible 'assistants' and

clunky software interfaces, whether they are one of at least 25,000+ Alexa Skills or a lengthy list of Google Actions. Because this is the early stage of platform wars, innovators must be creative in getting a 'skill' in one environment to be an 'action' in another.[40] Shortly after CES, Google created a directory of its Actions, which may be used with Google Home or Google Assistant, also on smartphones or tablets.[41] And skill and action creators are wondering – how will they make money at this endeavor?

"Yes, this is a simple way to access information and music as first steps. But that is always the way with technology – then it starts to move onto more complex aspects, even deep apps that affect your life." – David Inns, CEO **GreatCall**

- **Lack of traditional design personas and scenarios may hamper quality.** The processes to write skills, actions or other interfaces must adopt tried-and-true design approaches, including use of personas to simulate multiple use cases and scenario design for each persona that anticipate usage outcomes. For example, age-and-profile demographics matter – is the user 50-65, active and with a healthy lifestyle? Or is that person older and likely to be socially isolated, at risk for health issues? Or as often the case today, is the use case reversed – with the younger user less healthy and active?

"Voice First interactions are 'micro moments' in the lives of those individuals. On the one hand, 'Can I schedule a tee time?' and on the other, 'I am not well and need to speak with my daughter.'" – Heidi Culbertson, Founder, **Marvee**

- **Develop Voice First predictive analytics.** The collection of Voice First data on the back end may provide an opportunity to understand intonation and how a voice is projected, forming a 'Voice Footprint' for individuals and care providers who have given permission for voice and speech analysis. Change can be detected – for example fainter voice, slurred speech, emotion or other signs of cognitive or physical decline could be noted and appropriate care providers could be alerted.

"The voice-enabled user experience could be offered to providers as "Voice (or speech) Insights as a Service" – deriving meaning from changes in volume, intonation and emotion."
– Alan Bugos, Head of Technology and Innovation for **Philips Lifeline**

VOICE FIRST AND OLDER ADULTS – LOOKING AHEAD

Design improvements that benefit all will benefit older adults and caregivers. Unlike niche hardware and software for seniors, basic Voice First platforms and software will change rapidly and without disruption for users – accompanied by a 'What's New' weekly email and a few suggestions on new tricks to try – but the changes behind the front-facing features will make the most difference. With the 2018 lens to guide the market today, here are a few ways the user experience and thus the ecosystem may ratchet upwards:

- **Natural language and especially AI will improve – no upgrade required.** Given the hype about AI and corresponding investment to hire talent and build capability, it is likely that Version 2.0 of Voice First offerings will be more powerful than today's "I'm not sure how to help with that" variants (see **Figure 9**).[42] Market acceleration – whether it is for self-driving vehicles or new forms of employee-less retail – is producing improvements faster than consumers can absorb them. And because AI improvements are cloud-based, users will not have to update to benefit from advances and new features.

"Conversing with a senior about health – that task requires AI at multiple levels: the VUI layer, the user record layer, and each of the responsive/predictive use cases of healthcare."
– Stuart Patterson, CEO, **LifePod Solutions**

Context will be retained across devices to enable 'conversation'. In this new market year of Voice First technology, information about the user has been responded to in rudimentary ways and with little or no memory of how the dialogue began. Combinations like "What is the weather tomorrow in Boston" and a follow-on "Will it rain the next day?" bump into a natural language processing barrier – what place does 'next day' refer to? Expect improvement in ability to retain context – and even situation-specific responses like "Are you okay?" and "Who should be contacted?" when someone says, either at home or out and about: "I've fallen and can't get up" or "I am in pain."

- **Profiles will link to status and frailty to make the conversation relevant.** User profiles today are at a version one level of evolution – your name, your voice, your previous shopping or online search queries. Moving forward, profiles are likely to become more robust, linking across environments like health and travel records and preferences that extend beyond "Would you like to book the trip?" to a deeper examination of preferences that can launch a follow-on set of questions. For those who are low vision or cannot use their hands, the next few spoken statements might ask about interest in audio turn-by-turn assistance or car services that accommodate wheelchairs.

"What if people with sight impairment could interact with a device for life enrichment? Simple things such as what's the weather like outside, play music, and ask time of day. Voice recognition can bring a whole dimension to those who have disabilities. – Sheri Rose, CEO, **Thrive Innovation Center**

- **The Virtual Concierge construct will be commonplace.** In the senior living community, early adopters have seen how useful a voice-enabled concierge can be – for making dinner reservations, requesting a seat at an outing, or participating in an activity. But a Virtual Concierge helps any who asks a question, with recommendations for restaurants, reservations, and travel arrangements. In the next iteration, the Virtual Concierge will explain its reasoning about why this and not that – in the same way Maps software shows alternative routes that were chosen because they are 2 minutes shorter.

- **The Voice First personal health coach will be wise.** With more context, personalization and related processes, Voice First personas will be capable of giving advice, knowledgeable about the individual and also aware of what's happening outside – like knowing there is a snow storm or when the next bus is arriving.

"These technologies could make smart suggestions, offering personal coaching in the home – like noting data from a sleep tracker that indicates a bad night and setting the alarm wake-up for a later time." – Erin McInrue Savage, Senior VP, **AgeWave**

- **Voice First follows you outside the home – in car, portable and with your identity.** Cloud-based software like Amazon, Facebook or Google have trained us over many years to expect to be recognized across all the devices we use.[43] So too, does the cloud software in Voice First technology enable us to take our profile-based preferences into the car and on the road, climbing into our Ford and asking to play the drive time favorite.

From	To
Skills and Actions	Services
Devices with software	Integrated systems
In-room only	Environmentally aware
Limited or no retained context	Context of prior statements, profile
Notifications and reminders	Conversations
Conversations	Personalized Relationship
Ad-hoc partner revenue	Partner segments deliver revenue

Figure 9 Version 2.0 of Voice First technology will mature

Conclusion

For the past decade, software designers and developers have been driven by a "mobile first" mindset, building mobile apps first and desktop applications second. A new trend has emerged, pushing developers to shift from mobile first to "Voice First." Voice First refers to applications that people control primarily by speaking, leveraging the latest developments in Natural Language Processing. While Voice First has obvious benefits for those with visual and motor difficulties, it will improve the quality of technology interactions for all users.

Interviewees for this report were from:

AARP

Accenture

AgeWave

Amazon Services

Brown University

CDW Healthcare

Commonwealth Care Alliance

Consumer Technology Association

CTA Foundation

Front Porch

Google Assistant (Consultant)

GreatCall

Hasbro

Intuition Robotics

Jewish Homes San Francisco

LifePod

Longevity Network Advisors

Marvee

OnGuardian

Orbita Health

OurVoice.net

Philips

Senior Portal

Sensely

Stanford Center on Longevity

Tellables

Thrive Innovation Center

Trancendent Technologies

United Health Group

UnaliWear

University of Basque Country

Laurie M. Orlov, a tech industry veteran, writer, speaker and elder care advocate, is the founder of **Aging in Place Technology Watch,** a market research consultancy that provides thought leadership, analysis and guidance about technologies and related services that enable boomers and seniors to remain longer in their home of choice. In addition to her technology background and years as a technology industry analyst, Laurie was a certified long-term care ombudsman and received a graduate certificate in geriatric care management from the University of Florida.

In her previous career in the technology industry, Laurie held senior positions in IT organizations, followed by 9 years as a leading industry analyst at Forrester Research. While there, she was often the first in the industry to identify technology trends and management strategies. She has spoken regularly and delivered keynote speeches at forums, industry consortia, conferences, and symposia, most recently on the business of technology for boomers and seniors. She advises large organizations as well as non-profits and entrepreneurs about trends and opportunities in the age-related technology market and was a participating expert on the Think Tank for The Philips Center for Health and Well-Being, as well as testifying before the US Senate on the role of technology for aging in place. Her perspectives have been quoted in Business Week, Forbes, Kiplinger, the New York Times, and the Wall Street Journal. She has a graduate certificate in Geriatric Care Management from the University of Florida and a BA in Music from the University of Rochester. Her other research reports include **Next Generation Response Systems (2013), Challenging Innovators to Design for the 50+ (2014),** and **Baby Steps: Will Boomers Buy into Mobile Health? (2015), Tech-Enabled Home Care (2017), The Future of Voice First Technology and Older Adults (2018), and Technology for Aging in Place Market Overview (2018).**

Appendix 1

Scenario for the disabled – a real-world case study

How Alexa and smart home technology helped give my mom some independence

"About five years ago my mother suffered a stroke at the age of 62. Fast forward 5 years, my mother lives in a nursing home. She is dependent on the staff for most common day functions (i.e. turn on the tv, open the shades, turn the lights on/off). For the last 18 months my mother has been a user of Amazon Alexa as well as additional smart home products. These products include, smart shades, smart lights, smart TV controls, and smart plugs.

Smart products have allowed my mom to regain some of the independence that she has lost since her stroke. When she wakes up in the morning she says, "Alexa, Good Morning", this then triggers a "scene" that opens her shades, turns the lights on to 50%, and turns on the TV. When my mom is ready to use the bathroom in the morning she says, "Alexa, Use the Bathroom", this then triggers a "scene" that turns the light on outside of her room to a yellow color. This yellow light indicates to the staff that my mother needs to use the bathroom.

My mother also has become more connected to the outside world through Alexa. This includes using various radio "skills" that allows her to hear the news for example. My mother also uses Amazon Music Unlimited to listen to her favorite musical bands. My mother also challenges herself to learn more about Alexa each week, which includes learning about new skills that are launched on Fridays. Alexa has also helped her to become more social with the other residents by sharing facts she has learned through Alexa, such as interesting questions on the Jeopardy "skill". She also uses Alexa to make calls to her family.

The process: 30-day learning curve; no Wi-Fi in memory care; ECUs billed at $10K; Logitech Hub ($70) integrates with Alexa to turn on lights and open shades. Philips Hue light outside door. Alexa learned voice pattern within 30 days."

Appendix 2
Voice First and Voice Recognition Examples in Senior Care

AARP Foundation and Senior Living. The AARP Foundation recently **piloted a program with a senior living facility in the Baltimore area** to test whether voice-controlled technologies like the Alexa-powered Amazon Echo can help curb isolation and its associated health effects in seniors. The organization worked with Comprehensive Housing Assistance, Inc., to place Amazon Echo devices in its senior living communities, teaching them how to communicate voice commands to Alexa for everything from turning the lights on and off, medication reminders, and getting news and weather reports.

Amazon could take on Home Care. As Amazon looks to possibly capture some of the market share in the pharmacy space, home care providers are keeping watch on the company for other reasons. Coupled with its home-based voice technology, Amazon's Echo product could easily be paired with home health and home care services to fulfill responsibilities for seniors needing care. And some home care and home health providers are actively exploring these options, including California-based Libertana Home Health, which tapped Amazon's Alexa for a **pilot study** with some of its clients.

Juniper Saves Money Retains Staff. Products like the Amazon Echo have already **made their way** into senior living settings, allowing residents to hear the dinner menu or get medication reminders simply by asking for them. But voice recognition also holds promise for making clinicians' lives easier, while enabling senior living companies to cut costs and improve retention. least, Juniper Communities believes this to be true, based on initial results from a technology pilot with a startup called LexiconAI.

HoneyCo Smart Home for Seniors. Stringing together an array of smart devices into a home is no easy task for even a moderately tech-savvy individual – let alone someone enjoying their retirement. HoneyCo, based in Nashville, offers a one-stop shop for the smart home, taking products off the shelf and corralling them into a single, easy-to-use software platform. HoneyCo charges a monthly fee to manage the service.

Appendix 3
Setup for Amazon Echo and Google Home as of February 2018

1. **Download the Alexa app and sign in.**

   With the free Alexa app, you can set up your device, manage your alarms, music, shopping lists, and more. The Alexa app is available on phones and tablets with:

   - Fire OS 3.0 or higher
   - Android 4.4 or higher
   - iOS 8.0 or higher

   To download the Alexa app, go to the app store on your mobile device and search for "Alexa app." Then select and download the app. You can also select a link below:

   - Apple App Store
   - Google Play
   - Amazon Appstore

   You can also go to https://alexa.amazon.com from Safari, Chrome, Firefox, Microsoft Edge, or Internet Explorer (10 or higher) on your Wi-Fi enabled computer.

2. **Turn on Amazon Echo (1st Generation).**

   Plug the included power adapter into Amazon Echo (1st Generation) and then into a power outlet. The light ring on Amazon Echo (1st Generation) turns blue, and then orange. When the light turns orange, Amazon Echo (1st Generation) greets you.

3. **Connect Amazon Echo (1st Generation) to a Wi-Fi network.**

   Follow the guided instructions in the app to connect Amazon Echo (1st Generation) to a Wi-Fi network. To learn more, go to Connect Echo to Wi-Fi.

   Tip: If your Amazon Echo (1st Generation) doesn't connect to your Wi-Fi network, unplug and then plug the device into a power outlet to restart it. If you still have trouble, reset your Amazon Echo (1st Generation) to its factory settings and set it up again. To learn more, go to Reset Your Echo Device.

4. **Talk to Alexa.**
   You can now use your Amazon Echo (1st Generation) device. To get started, say the "wake word" and then speak naturally to Alexa. Your Amazon Echo (1st Generation) device is set to respond to the wake word "Alexa" by default, but you can change it at any time. To change the wake word by voice, you can say, "Change the wake word." You can also make this change in the Alexa app, by going to Settings, selecting your Echo device, and then selecting **Wake word**.

Google Home Instructions as of February 2018

1. Plug in your Google Home
Your Google Home plugs into the wall and, after a few minutes, will light up and start looking for your phone. There's no on/off button. It's always on when it's plugged in. Stay nearby with your phone.

2. Download the Google Home app from your phone's app store and open the app
Download from Google Play or the App Store. Accept the terms of service and agree to turn on location permissions. Yes, Google's spying on you. By having the Google Home, you're all in. Might as well let it know where you are. Make sure you are connected to your home Wi-Fi network, as your phone will pass that information to the Google Home.

3. Sign in with a Google account
You'll need a Google account to use Google Home; preferably one with a gmail.com address. If you don't have one, now's the time to pop open your browser on your PC, go to Gmail.com, and set one up.

4. Don't allow email notifications
We don't need more spam. You're going to have to do this twice.

5. Tap the setup icon in the upper right-hand corner
Now, tap Sign In and set the location of your Google Home hardware. The speaker needs to do this so it can give you local weather and commute times.

6. Link your music service
Google Home supports four music services: Google Play Music, YouTube, Spotify, and Pandora. To get the most out of it, you need a Google Play Music or Spotify premium account. Those will let you request specific songs and albums. With the free services, you'll only be able to listen to themed stations or artist mixes. Google Home can't access your purchased or local music libraries.

7. Step through the tutorial
Now you'll get some tips on how to use the Google Home, and fun things to ask it. My daughter likes to ask it how to spell words when she's doing her homework.

8. Tap the left-hand menu button, then More Settings
Let's set up some of the optional features on the Google Home. You can get to them through the menu accessed by tapping the three-line icon in the upper left hand corner. Tap More settings to see the full list.

9. Change your news and My Day settings
When you say "listen to the news" or "tell me about my day," you can get customized information from your Google Home. Tapping News, then Customize, lets you change your news sources—for instance, from NPR to Fox News. Tapping My Day lets you change a few options in the daily briefing.

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