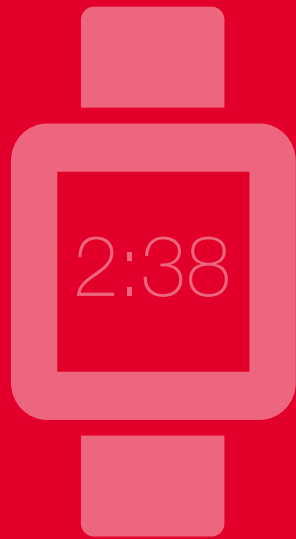# *Wearables: Driving user outcomes in the Digital Age - the next leap*

July 2015

pwc

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Wearables: Driving user outcomes in the Digital Age - the next leap

The potential of wearables is extremely promising, as it offers myriad possibilities of intelligent interactions that ease the frictions of daily life, not to mention personalized applications as well. Therefore it is only a matter of when, not if, the adoption of wearables will take place. Apple has demonstrated in the past that it is well-positioned to create demand for its products through attention and dedication to the user experience. So we can expect the company's entry into the smartwatch space may drive the growth of the overall wearable market. Analysts expect over 130 million wearable devices will be in use by 2030, with a market worth almost US$ 6 bn. In the Netherlands alone, we forecast that smartwatch adoption could reach a userbase close to 9 million by 2020.

A key feature of wearables would be the fact that they are 'always on' and possibly 'always online'

PwC NL recently conducted a survey on 900 Dutch consumers, mostly within the ages of 20 to 60, on stance towards smartwatches.[1] The survey presented different options of smartwatches catered to four focus areas such as lifestyle, fashion, health and social media. About half of the participants intend to purchase a smartwatch in the near future. But what are wearable electronics, or 'wearables' anyway? As the name already suggests, these are a class of electronic devices that are portable and can actually be worn by users. A key feature of such wearables would be the fact that they are 'always on' and possibly 'always online', leveraging advanced sensors and wireless connectivity to enhance interactions between the wearer and his or her environment, not just reactively but also proactively. In a sense, wearables can also be considered as a special category in the larger family of Internet of Things (IoT), since they are all trying to adapt new applications from the abundance of cheap antennae and sensors.

However, for wearables to be compelling, there are many aspects to be addressed in the ecosystem, some more essential than others. The pace of adoption of general-purpose consumer wearables (as opposed to highly specialized wearables with niche industrial applications) will strongly depend on the functionalities they offer and the scale and scope of the ecosystem they can be deployed in. An infrastructure that is not only capable of supporting single products but also the network of connected devices is currently lacking. Wearable-specific technologies - such as geo-tracking, contactless data transfer and biometric sensors in health, Internet of Things and wireless payment environments - need to be comprehensively deployed to present compelling solutions and drive adoption.

Moreover, it is time to discuss market-based solutions to handle the influx and use of personal data in such a way that the user's best interests are protected. Perhaps the wide acceptance of wearables and IoT can encourage the development of such services and the ecosystem. We are on the verge of this new world.

To push for the mass adoption of wearables beyond the historical growth rate of the tablet market – to about 9 million Dutch consumers in the next five to eight years – would involve leaning on some key drivers. In our view, the action points on the right would yield the greatest benefits.

Taxonomy of mass wearable adoption

Availability of a full range of intuitive, user-centric applications in an open and extensive ecosystem

Proliferation of services leveraging hyper-location tracking and/or ubiquitous computing for contextual and seamless affordances

Contactless data transfer and broad compatibility with IoT applications

Biometric sensors for full suite of personal health tracking and management

Seamless transactions (e.g. secure payments) leveraging digital wallets for increasingly mobile lifestyles

Affordable functionality and/or sophisticated fashionability appealing to a broad range of customer segments

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1 This survey was performed together with Veylinx, a Dutch market intelligence company specialized in behavioural consumer research.

A day in the life of a smartwatch

A soft glow appears in an otherwise dark room, as I wake from my hibernation. As scheduled, I sync with the local time server just in case, and find that sunrise is due in thirty minutes. I connect to the smart-home OS to gradually roll up the window blinds letting in natural light, and set the kettle to boil . I then shift my attention back to my user. Judging from Mark's heart rate and body movements, he's mid-way through another REM sleep cycle. I modify the alarm time he set earlier by seven minutes to ensure he wakes up optimally just after the present cycle.

Once awake, Mark requests to catch up on the news while he is getting ready. I tap into the smart-home's radio and speakers to read out the latest headlines on the morning news, expanding on details when he asks. Sensing that Mark has finished his bottle of milk, the smart-fridge sends me an authorization request to top-up snacks and groceries in the fridge. Once he authorizes the transaction with a secure biometric click, I share the shopping list with the local supermarket, but anonymously as Mark has opted out of sharing identifiable details with this party.

Halfway through coffee, a third-party route advice company sends a ping informing me that a traffic jam is developing on the nearest highway and suggests alternative routes. I suggest to Mark that he should leave slightly earlier than usual taking into account the recommended detour. Mark grabs me off my charging hub and puts me on. As he rushes out the door and as I cross the geo-fenced area of smart-home sensors, the smart-home OS automatically locks the door behind us, turns down the radiator to an energy-efficient low, switches off unnecessary appliances, turns on others like the Roomba, and also activates home security.

While in the garage, the car-door clicks open as it senses me approaching. As the car's OS greets Mark, I send it the new route we chose, and it shows up on the dashboard screen. In his hurry, Mark occasionally exceeds the speed limit, but I vibrate gently to tell him to slow down. Mark's arrival is automatically detected by intelligent carpark OS and the car's GPS display syncs and updates to show the route all the way down to the day's parking spot in the office parking complex.

As he gets into the elevator, I run through the flashcards for the topic and location of the next meeting, with minutes from previous meetings, and Mark's notes on key issues to address. While giving the presentation, I automatically put Mark's phone on silent, and help him keep time by gently vibrating every thirty seconds. The daily ritual of deciding where to have lunch as a group is no longer a hassle these days. At lunchtime, a dynamic poll goes around the office, and everyone votes for the different options for restaurants directly on one of their connected devices, updating a large common screen in the lobby in real-time. Of course, the votes automatically get registered as reservations at the respective restaurants once they are confirmed. On the way, I remind Mark to eat light, since he has an early dinner date with his girlfriend. And of course, paying is as simple and secure as tapping against the scanner on the way out.

Heading home after the date, I take a stand and lock the car from starting in manual since Mark has had alcoholic beverages, in accordance with the law. Three cheers for driverless cars. I then ping to alert the home automation system to prepare for Mark's arrival, such as turning up the central heating among other things. As the car nears the garage, the smart-home sensors detect Mark is within range, and switches on the lights. No need to worry about feeding the cat, because the fridge has auto-dispensed food early in the evening, and the cat's wearable medical patch has administered a timely dose of insulin.

With the good feeling of a day well-spent, Mark heads off to bed after setting the alarm. The bed wishes him goodnight, and starts playing soft soothing music until it detects he has drifted off into a deep sleep. Meanwhile, I automatically sync Mark's physical activity data for the day to the secure database of his health provider, excluding any location or duration information as per his privacy settings. Finally, after a whole day performing a variety of tasks, spanning a host of roles from biometric nanny to personal assistant, I enter hibernation mode in my charging stand.

Smartwatches have the potential to change daily life as we know it.

The rise of wearables is within sight

Apple users, users who like innovative products, and those who purchase apps online, all registered higher willingness-to-pay than other survey participants.

Although this day's itinerary may sound futuristic to you, you can be sure that most if not all of the applications described above are technically possible, and more importantly, already economically realistic. All that's missing from the picture are merely the fascinating devices themselves in the hands of actual users. This is why the release of the Apple Watch could be a watershed moment for the rise of wearable electronics.

Wearables are not entirely a new concept; pedometers and wrist-worn calculator watches have graced the tech landscape before. However, in what a former WIRED editor calls the 'peace dividends of the smartphone wars', miniaturized networking and sensors are now cheap and widely available at scale, therefore inviting players both big and small to adapt them to other killer applications. The cumulative effects of computing power, connection speeds and reliable mobility present ripe opportunities for seamless interactions with the modern environment, and novel personal experiences.

One important point to realise is that wearables themselves are only a piece of a bigger puzzle, as they easily link up with for instance IoT, smart automation, and big data. When combined, these technologies offer companies and consumers alike a chance to collectively get an unprecedented 'big picture' of today's complex world.

As shown above, there is a plethora of opportunities for these technologies to improve daily life and interactions of consumers. It is now up to companies to design new solutions and consumers to adopt these technologies and explore their full potential.
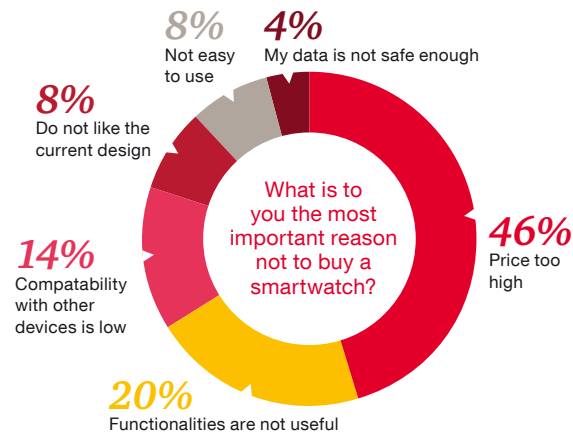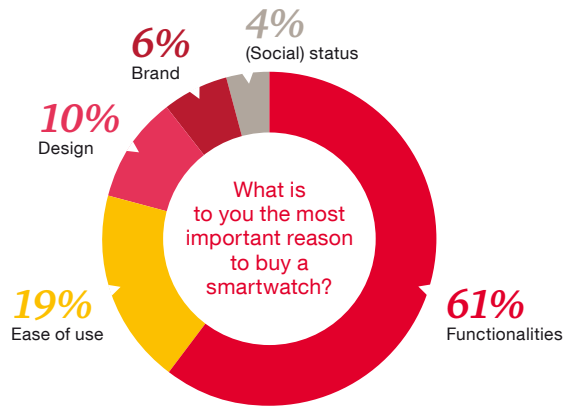
Our projections suggest that there will be close to 9 million smartwatches in use by the year 2020, presenting the potential for a large user base for wearable-to-wearable interactions. On top of this, we can expect a fast-growing Internet of Things, significantly enlarging the size of the ecosystem.

Projected smartwatch adoption 2015-2020 (x1.000)

volume # of wearables sold

| 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
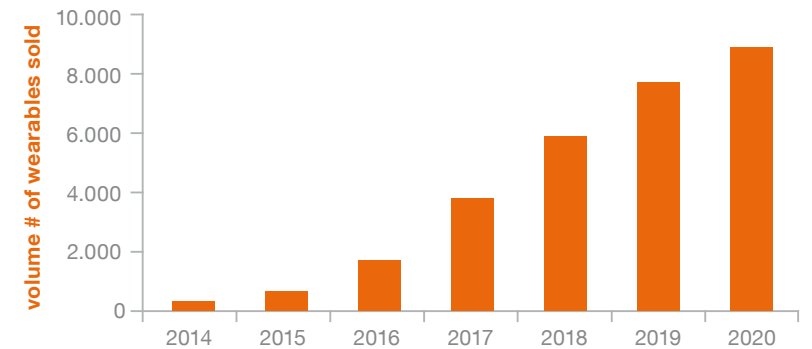
Generally, users who believe they know a lot about innovation, and prefer to buy innovative products, registered a higher willingness-to-pay. However, participants who considered themselves tech-savvy early adopters had a lower willingness-to-pay for a smartwatch than others. It is possible that early adopters have already purchased other wearables, and hence are likely to estimate prices close to their existing devices. Also, the willingness-to-pay for consumers is generally not higher than 500 €, and about 50% of the participants indicated they would not buy a smartwatch if the price was too high. This suggests that the prospects of mass adoption of wearables are favourable below this price point; but above this figure other factors such as fashionability, branding or social status would have a large influence.

6%
Brand

4%
(Social) status

10%
Design

What is to you the most important reason to buy a smartwatch?

19%
Ease of use

61%
Functionalities

8%
Not easy to use

4%
My data is not safe enough

8%
Do not like the current design

What is to you the most important reason not to buy a smartwatch?

14%
Compatability with other devices is low

46%
Price too high

20%
Functionalities are not useful

Aesthetics and personalisation are key drivers of adoption of consumer wearables, since they straddle the thin line between technology and fashion.

The extent to which smartwatches will gain popularity depends largely then on the innovative features they offer. A smartwatch that effectively replicates features that smartphones already have would present a less compelling option. How 'smart' smartwatches are, for example, would depend on how they automate a plurality of interactions between the wearer and his environment seamlessly. It is quite trivial for a wearable to pick up and display signals from the surroundings, but can we equally use our wearables to reach out and actively change some settings, like a universal remote control for the world?

The survey also found that participants who have purchased apps online, especially games, showed a higher willingness-to-pay for the smartwatch. Given that Google and Apple play leading roles with their Android and iOS platforms respectively, featuring well-populated app stores that add value across their ecosystems, eager consumers of apps on these platforms could be a ready go-to market for the first wave of wearables. Survey participants with existing Apple mobile devices – i.e. running on iOS – consistently registered a higher willingness-to-pay. So, we expect that the present market shares of iOS and Android may significantly influence the penetration of related wearables.

Wearables must offer extended and seamless functionality to be compelling to users, and companies can leverage network effects to achieve this

Of the participants who intended to buy a smartwatch, close to 60% indicated they were primarily interested in functionality. Wearables gain most value by tracking, collecting, and intelligently using user data for tangible lifestyle benefits. Such a wearable might trigger contextual interactions with the environment, or remind its users to complete their daily quota of healthy activities. Wearables can augment people's daily lives with real-time information and helping to make improved decisions. The wealth of data can benefit individuals by allowing them to track their own health with unprecedented transparency, and can provide businesses with deeper insights for more personal connections with consumers. Almost a quarter of the survey participants also indicated that they would use a smartwatch at least as often as a tablet in 2016, which is a promising outlook for this new market.

Companies deploying wearable technologies should think of wearables less as individual products, and more in terms of the positive network effects that increase with the size of the technical ecosystem in which they are deployed. Being the only person in the world with a mobile phone would make no sense; similarly wearables could become exponentially more useful with every additional user and connected 'thing' on the network.

Network applications could offer features which go far beyond merely tracking personal fitness data and providing social notifications. From the PwC NL survey, it was found that smartwatches shown with different specifications among the four focus areas – namely lifestyle, fashion, health and social media – did not significantly affect the willingness-to-pay. This suggests that the choice of a consumer smartwatch might be largely associated with its broad compatibility to the user's lifestyle, rather than niche applications.

We can also expect that seamless interconnectivity of devices would be a significant factor in the adoption of wearables by greatly extending functionality. The consistency of information transferred between devices is critical to wearables' success, and has important implications for useful interactions within the ecosystem. Aside from Google and Apple, Microsoft is also stepping into this space with an expansive unified vision for Windows 10 across all hardware platforms including computers, tablets and IoT appliances. As these big players vie with one another in carving out market share, users might experience inefficient fragmentation of environments where their devices can seamlessly co-operate.
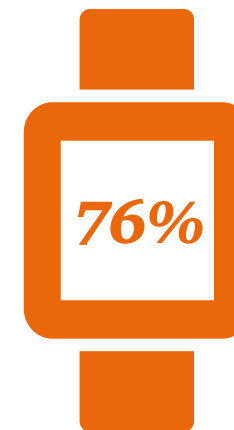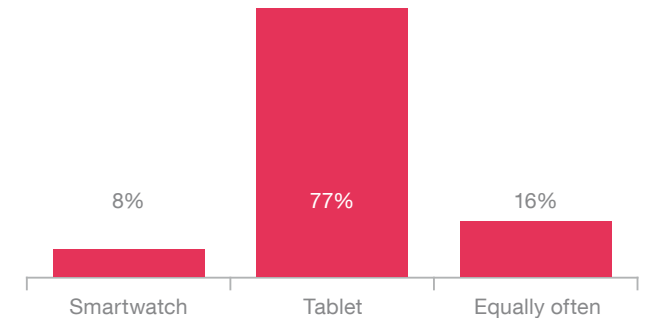
Consumers who are most likely to buy an Apple Watch are those who already own an iOS device, value fashion, branding and user-friendliness, consider themselves to be tech-savvy.

Which of the following devices do you expect to use most often in 2016?

Smartwatch	Tablet	Equally often
8%	77%	16%

New smart devices don't have to replace the smartphone

76% of consumers say they would NOT need their wearable device to replace an existing piece of technology in order to justify its purchase.

Alternatively, the rise of common open standards for inter-device communication might alleviate these concerns. Indeed Google and Microsoft have expressed keen interest in opening up their platforms to make the adoption of devices across OSes a more compelling proposition. Open standards could be a key enabler for the adoption of wearables. Just as the growth of mobile OSes depends a great deal on access to third-party apps on open platforms, we expect similar trends for the IoT ecosystem.

Currently, the number of connected devices that can communicate and respond with one another, including wearables, is small. Households only have few options for appliances like smart thermostats, lighting, coffee machines, and weighing scales that offer some options for interaction with wearables. Similarly in retail stores, wearables with access to user preferences could sync with beacon technology to provide recommendations or direct customers to promoted products. Wireless payment technology too is still in its infancy. Some specialized sports goggles offer augmented reality information for extreme sports athletes to make adjustments in real-time, a tantalizing promise of augmented situational awareness. And of course, smart spectacles like Google Glass or Microsoft HoloLens could have applications in guided learning and instructions for complex tasks. The IoT ecosystem, and therefore the market too, are not yet saturated and this presents a great opportunity. We can expect that the bigger the ecosystem becomes as it matures, the higher the functionality of a wearable will be in that ecosystem, thus driving the pace of adoption of wearables.

Affordability is a key consideration when deciding to buy a wearable, and once bought, it is a matter of functionality and compatibility.

Companies interested in wearables should prioritize quality design experiences and offer options for personalization to compel fashion-conscious users

Consumers may be open to sharing their data if there is a clear benefit for them to do so, and communicating these benefits clearly and trans-parently could increase willingness to share.

The 5 second rule - Our research has shown that the user centered design on applications for smart watches should cater for user-centric outcomes within 5 seconds, as users are unlikely to hold their wrist up and look at their watch for more than a couple of seconds.

Design is a key driver for the adoption of consumer wearables, both on the hardware and software side. 16% of the survey participants indicated that they would not buy a smartwatch if the design was not good enough or if it were not easy to use. Since wearables generally will be visibly worn by their users, the aesthetics and user experience of these devices become key considerations. In the survey, one in five participants indicated that design, ease of use, brand and/or status would be a key factor when buying a wearable.

What the Apple Watch offers, beyond the technology and unlike most competitors, is a complete suite of personalization options, such as a wide choice in size, material and design for wristbands. From this, we can deduce that Apple is committed to individual preferences, positioning their Watch as a fashion product, or even as an luxury ornament. This is actually an astute move in recognition of the fact that wearables straddle the line between technology and fashion. Like clothing, wearables must offer not just usability, but also a sense of uniqueness – who wants to be seen wearing the same attire as everyone else?

Indeed data from the PwC survey corroborates that the Apple Watch in particular might appeal to a fashion-conscious audience. The study found that users who are most likely to buy an Apple Watch are those who own an iOS device, value branding and user-friendliness, consider themselves to be tech-savvy, and spend more than 150 euros a month on clothing. Moreover, the survey found that willingness-to-pay was higher among iPhone 6 owners, and, to a lesser extent, among iPhone 5 and iPhone 5s owners as well. If anything, survey participants who were shown an explicitly branded Apple Watch (i.e. with the logo) registered a higher willingness-to-pay than participants that were shown a non-branded watch. This bodes well for sales expectations for the Apple Watch.

On the software side, user experience (UX) plays an important role.

In a market saturated with innovations for innovation's sake, wearable applications especially should be anchored in human-centered design. For wearables to be truly effective, they need to provide information that is not just descriptive but also prescriptive, with a quick and clear call-to-action, and only when needed.

Given that wearables will likely augment our senses, (unnecessary) information overload, could be annoying if not dangerous. So, it is imperative that wearables are designed to capture a minimum of attention and, equally important, are refined enough to facilitate the user's presence in the physical world rather than the digital. This means that apps and services would have to be developed that put the user in the centre, promoting meaningful applications and leveraging interconnectivity for seamless affordances.
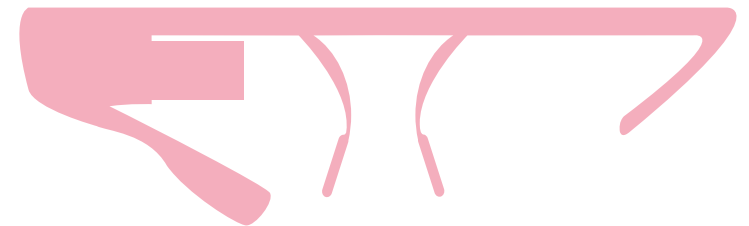
When applied well, wearables help service providers to deliver usage and consumption outcomes for their services to their clients and users

From a technical standpoint, as the penetration of smart products increases into our daily lives, the opportunities for interaction between wearables and these ubiquitous technologies will also become clearer. Wearables are an important link in this chain, given how they can capture usage and habits with unprecedented detail thanks to their mobility. Wearables can make an increasingly positive contribution to our lives as more data are collected and analysed. Patterns in the data can be applied in numerous subtle ways to ease many of the frictions of daily life – imagine for instance home security that activates and shuts down automatically, computers that use secure biometric passwords, and car doors that unlock when the smartwatch is near. Industries can expect increased transparency and efficiency from real-time information and location data. These can breathe new life into aspects of workforce training and communication. This is an area ripe for new applications.

Wearables can improve efficiency, productivity, service and engagement across industries and provide users with tangible insights into their lifestyles.

Retail:

- Integrated shopping experience
- Shopping insights
- Payment and point of sale
- Customer service
- Targeted advertising
- Loyalty programs

Healthcare:

- Diet & exercise accountability
- Access to medical information
- Clinical trial participation
- Accurate diagnosis

Entertainment & Media

- Immersive and fun experiences
- Relevance of content and solutions
- Seamless engagement with media and devices
- Advertising inventory to drive eCommerce
- Sophistication of gaming solution

Selected examples of functionalities for improved user outcomes through wearables

Wearable technology allows companies to communicate with each consumer in a personalized way, which is an opportunity uniquely enabled by the capacity to handle and interpret unprecedented amounts of data in time.

> For wearables to reach its true potential, users should be enticed to let their wearables interact seamlessly with a wide range of IoT-applications.

One underrated area so far has been personalization of the customer journey.

On a personal level, the sensors on wearables can capture a multitude of data points about the individual. These metrics of course can be submitted to health service providers for example. More than US 200 million in venture capital has already been invested in health-related wearables. One as-yet unexplored area for these metrics could be beneficial to the user himself. For example, the wealth of health data could be visualized to answer more prosaic questions in life, such as: How much stress does my new job bring about? How do the seasons affect my metabolism? In this sense, wearable technologies can passively capture such information, and visualise lifestyle patterns in ways that add immediate value to the user.

For consumers, applications of wearable electronics include quantified self-measurements for personal healthcare and augmented reality overlays for richer information about the world. A recent art project used biometric data to showcase the possibility that the world around the user responds to biometric signals. Picture for example a teabag that automatically dips in the cup at the same rate as the user's heartbeat, viscerally mirroring how stressed or relaxed the user is.

From a market knowledge perspective, consumer data of course represents a great opportunity. Operational efficiencies could be maximized, and big data about consumer habits could feed the intelligence behind recommendation engines. Wearables can also radically upend traditional retail experiences. Companies will see new opportunities to connect with consumers on a more personal level based on lifestyle choices. In this sense, wearable technologies have the potential to change advertising and content as we know them today.

One underrated area so far has been personalization of the customer journey. With customer data coming from personal wearables, companies could get unprecedented insight into individual preferences and patterns. These data would allow companies to communicate with each consumer in a personalized way, which is an opportunity uniquely enabled by the capacity to handle and interpret unprecedented amounts of data in time.

Of course, this means customers should be willing to share their data with companies in the first place. Effective and accurate personalization can only be enabled by finding patterns from thousands, if not millions, of consumers' data. There is an inherent tradeoff here. On the one hand, the data that consumers share could be used with a user-centered perspective to significantly improve products and services, thus adding value and improving the user experience. On the other hand, there is the potential for abuse of customer data if the data - or the patterns they reveal - are used opportunistically, or worse yet, shared with other parties without permission. Consumers have vocally expressed their opposition to such behavior in the past. So this is a path that companies should tread carefully, and as transparently as possible.

Control over personal data is a key concern among consumers, and the willingness to share data heavily depends on the purpose of sharing and the user value derived from it?
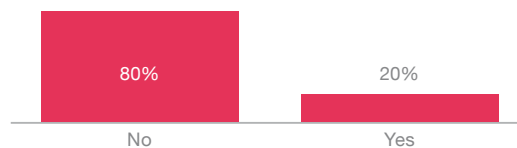
With the use of advanced sensors, wearables will witness, and record the daily comings and goings of their users. Therefore, one valid point of concern is the security aspects stemming from the collection and handling of sensitive information by connected and ubiquitous devices. Wearables in particular are very likely to capture personally identifiable information about users, ranging from health data to preferred locations and purchase histories. It would indeed be undesirable if these data were compromised in any way.

Consumers seem increasingly willing to share personal data but are wary of the data recipient and the way they can use it.

In general, the survey revealed that participants value the privacy of their data over having a smartwatch. For example, an overwhelming majority indicated that they would not prefer to share data with a healthcare provider or an employer. Equally, the extent of concern could also be dependent on the potential users of the data. For example, participants were less comfortable sharing personal data with employers than sharing data for medical research.

On the other hand, consumers who were willing to share data with health data providers showed a higher willingness-to-pay. Whether participants are willing to share data or not does not depend on number of the devices they already own, nor does it depend on whether they have Apple products or how often they shop online. So, the caution about privacy appears to be prevalent across the population.
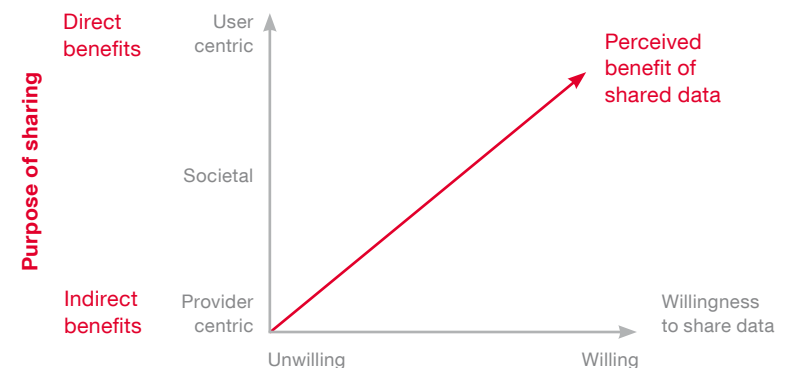
This suggests that consumers are willing to share data if they are reasonably satisfied with how their privacy concerns have been addressed. Consumers may be more open to sharing data if there is a clear benefit for them to do so, and companies that offer value-added services with customer data may find more acceptance in the market.

So, companies interested in wearables would do well to address data privacy and the ability to safely manage digital identities. Equally, this is a space ripe for trusted parties that can orchestrate data independence and facilitate digital trust, thus addressing privacy concerns through market mechanisms. For example, instead of consumers sharing their data directly with companies, there is the possibility of third-party data services. These independent trusted third parties could manage consumers' data in a way that protects the best interests of the consumers, and perhaps even shares some of the profits from data-sharing with those consumers.

Interestingly, participants of the PwC NL survey did not seem very fazed by the security concerns, with only 4% reporting that security would be the most important criterion in the decision whether to buy a smartwatch or not. In similar studies done by PwC in the US and Germany, a higher proportion of users expressed concerns about data security. Different levels of familiarity with the latest technologies, such as smartphones and cloud computing, could be a reason behind the spectrum of concern for security.

If your health insurance would give you a smartwatch in exchange for access to its data, would you accept it?

No	Yes
80%	20%

If your employer would give you a smartwatch in exchange for access to its data, would you accept it?

No	Yes
84%	16%

Perceived benefits of sharing data

Purpose of sharing — Direct benefits / User centric, Societal, Indirect benefits / Provider centric. Willingness to share data — Unwilling to Willing. Perceived benefit of shared data.

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