Wearable Technology: Automotive's Next Digital Frontier

Wearables represent the latest potential shift in consumer technology, with small, ubiquitous devices promising to have an impact similar to smartphones on the automotive value chain. Great promise, coupled with a lack of proven use cases, requires that companies proceed cautiously yet ignore wearables at their peril.

Executive Summary

With rapid advancements in technology and a reinforced emphasis on innovation and miniaturization, enterprises across industries are seeking to further “consumerize” IT by shifting focus from mobile phones and tablets, to wearable devices. Enterprises also realize the benefits of integrating wearable technologies into key business processes to introduce added operational efficiencies and create a better working environment.

Wearables are compact, smart, lightweight devices that typically offer ubiquitous connectivity and can be worn somewhere on the user’s body. They typically consist of one or more of three components: sensors, user interaction capabilities (ranging from a screen or simple bell to a vibration motor) and computing architecture. While in most cases connectivity is enabled through Bluetooth or Wi-Fi in conjunction with a smartphone, some devices have built-in cellular connectivity. These devices can collect, store and transmit data to other devices or to a cloud infrastructure and can easily pair with other devices, exchanging data and sharing computing resources to deliver a “ubiquitous computing” experience to the user.

While wearables have become relatively common in the consumer space as fitness trackers, or “smartwatches,” pundits don’t yet agree on whether wearables will be a smartphone-like game-changer in the enterprise space. Many businesses are still developing use cases and prototypes before fully embracing wearable technology.

This white paper addresses the rapid growth of wearables and their potential to radically change the automotive Industry. We look at industry examples in which wearables improve operational efficiency and enhance the customer experience. We also analyze the challenges that wearables pose, and present actionable recommendations on how enterprises can derive maximum value through their usage.

Applying Design Thinking

In the consumer space, wearables have been available for several years, and in some cases are available as second- and third-generation products. Gartner, an IT analyst firm, places wearable user interfaces at the peak of its “Hype Cycle.” According to IDC, wearables will transcend early
adopter status and will record a three-fold sales jump in 2014, with an expected CAGR of 78.4% to 111.9 million units in 2018. In keeping with these estimates, Amazon recently launched its first wearables store, making wearables a product category for the mass market.

Technology industry heavyweights such as Google, Intel and Facebook have launched an acquisition spree, acquiring several wearables technology companies. This provides these companies with capabilities ranging from hardware and software, to virtual reality and wearables-related analytics. In the consumer space, wearables have met with mixed results. Fitness-oriented wearables like Fitbit and Jawbone have received a warm market reception, while Google’s efforts around Google Glass and Android Wear have met with consumer adoption headwinds.

The primary goal of wearables is to obtain and deliver key information to people in real-time, at the exact point that they need it. In addition, wearables help achieve portability and human integration, leaving the user’s hands free to work on other tasks, while maintaining an ability to deliver data from a complex computing back end that might be hosted in an enterprise or public cloud. As such, they give users access to massive computing power while remaining mobile, and enable them to interact with other devices using gestures, vision and voice.

Wearables also enable the introduction of highly connected technologies in traditionally prohibitive environments, which is why they pose particular usage benefits to the auto industry. For instance, consumers expect wearable technologies to advance decision-making while they are driving a car by delivering an intuitive and interactive user experience without being a distraction.

Envision a scenario in which a driver’s smartglasses can give him real-time traffic alerts and prescribe the optimum route to a destination. Or take a case where a quality assurance (QA) worker in an automotive production facility can use smartglasses to perform a hands-free visual inspection of a vehicle, while inspection data is automatically relayed to the facility’s quality man-

Taking Action from Inputs

- Jenny is driving back home after a long, tiring day at work. Her car connects to her wearable device via Bluetooth to get biometric data. With this data, her stress level is determined to be above normal. The system responds to this by blocking phone calls, turning down the radio volume, and sending a “call back” message.

- Jim is a salesperson in an automotive dealership. He uses Google Glass cheat sheets to show off the features of cars in the dealership. He scans the barcode on the car using his Google Glass, which displays the information for that vehicle model in his line of vision. Jim is able to “wow” the customers with his automotive knowledge and effectively communicate the features, technology and telematics in the car to them.
agement applications. These are just a couple of scenarios among numerous possibilities that wearable technology holds for this industry. (For more insights on how wearables are poised to impact business, read “Google Glass: Insurance’s Next Killer App.”)

Wearables are set to be an important element in the larger ecosystem of the Internet of Things (IoT), in which the collective computing power of all the interconnected elements can be harnessed to aid data acquisition and decision-making. Each wearable is instrumented to continuously exchange data with its surroundings, forming a digital footprint that we call a Code Halo.™

Although these devices on their own can simplify business processes, their capabilities will be even more compelling when their Code Halos intersect with those of other connected elements within the IoT context map. At a very high level, wearables can use data from the human body and the external environment to stimulate action (see Figure 1, previous page).

Thanks to the advent of rich telematics data and wireless connectivity, cars are smarter today than ever. As Figure 2 reveals, several interesting use cases could emerge as wearables are connected to a larger ecosystem of “things,” including the car and driver themselves.

**Increasing Process Effectiveness**

Given how quickly wearables have moved into the mainstream, as well as the distinctive benefits they offer the automotive industry, several automakers and dealerships have rolled out specific pilot programs and are building business cases to drive widespread adoption. In the sections that follow, we examine several ways in which wearables could be effectively deployed to transform consumer and employee experiences in the automotive industry.

**Enhancing the Automotive Purchase Process**

Wearable technologies such as Oculus Rift® that deliver an immersive “virtual reality” user experience enable consumers to “test-drive” a vehicle without ever stepping foot inside it. Multiple auto
makers are implementing augmented reality into their go-to-market strategies. Product manuals, for instance, are now virtualized, allowing car shoppers or owners to simply hold their wearable device over a certain area of the vehicle to receive a virtual explanation of what it is and what it does through video, text or animated graphics. This will also allow customers to scan rows of vehicle inventory and quickly understand the features and functionalities of each.6

In the same way, smartglasses could also help salespeople at car dealerships work more effectively, as they would no longer need to rely on a paper manual to show off a car’s key features. Through the use of smartglasses, they could highlight salient features by citing information that is overlaid on the glass via augmented reality. In fact, some dealerships now have deployed pilot learning programs for their salesforce, using smartglasses to train them.7

Automotive customers already conduct a large amount of pre-purchase research online before purchasing a car. This paves the way for a whole new set of ways for consumer data from mobile phones and wearables to be utilized (with their permission) to enhance their in-store experience. Potential applications range from identifying customers and communicating their vehicle preferences when they enter a dealership, to guiding them to the exact model they viewed online through highly localized navigation and a series of directional messages to their wearable device.

Applying this form of Code Halo thinking would give dealerships insights into customers’ online preferences, which they could use to further integrate the online world – where most consumers conduct their primary car buying research – with the physical world, where actual product interactions occur, and most purchases are consummated.

Redefining the Driving Experience

Recently, several car manufacturers, technology and services companies have collaborated on developing prototypes and concepts to explore the potential of wearables enhancing the driving experience.

Several automakers are collaborating with wearable manufacturers to develop apps that remotely monitor and provide access to the vehicle using smartwatch technology.8 Nissan’s Nismo® smartwatch monitors metrics such as average speed, fuel efficiency and even the driver’s heart rate to detect fatigue. Mercedes has collaborated with smartwatch maker Pebble on an app that provides real-time information on vehicle status. Mercedes drivers can also use their smartwatch to be alerted to real-time hazards.

BMW has developed smartwatch prototypes for its i3 electric vehicle that allow users to check on battery status, driving range and door lock status, as well as receive notifications on the vehicle’s service or inspection needs. BMW plans to make this app available to Apple Watch users, as well. Tesla offers a similar Apple Watch app, and has even proposed that Watch will eventually activate self-driving features, allowing the driver to “summon” the car from a parking space and have it automatically drive to the wearer’s location.

Automakers are also building prototypes for Google Glass that leverage the ability of eyeglass-style wearables to deliver information directly into the wearer’s field of vision. Hyundai’s next generation of products, starting with the 2015 Genesis, will allow owners to connect with their vehicle using wearable devices. Hyundai’s cloud-based Blue Link platform makes features like remote start and service information quickly accessible through new devices like Google Glass.9

Mercedes was a pioneer in announcing integration with Google’s Glassware project in 2013, allowing the driver’s Google Glass to seamlessly exchange information with the in-vehicle navigation and telematics system. Routes and directions are overlaid via smartglasses onto the road, negating the need to look at a GPS screen.10 Audi and augmented reality company Metaio have also created a concept app that positions several built-in operations procedures from the car’s instruction manual in the line of vision of the user, allowing for an augmented reality user manual rather than a traditional print or electronic version.

Similar applications of Glass exist in vehicle manufacturing and service, with Glass providing augmented reality service, maintenance and inspection information. Future enhancements
could even include integration with parts ordering and service billing applications, allowing a service technician to diagnose a problem, order a part from inventory and view installation instructions, all via his or her Google Glass.

OEMs and technology companies are not far behind in these efforts. Harman’s new ADAS system analyzes real-time data from traffic cameras and alerts users to potential safety threats to other drivers that may encounter the threat via their smartglasses. DriveSafe has developed a prototype that prevents drivers from dozing off at the wheel by analyzing head and eyelid movements (using the built-in accelerometer in Google Glass). Inrix’s Google Glassware concept would allow drivers wearing Glass to get automatic and unobtrusive notifications of congestion or incidents on the road ahead, with the option of requesting an alternate route, with all interactions performed through simple voice commands.

Interestingly, Google ended sales of Glass to consumers in early 2015, choosing instead to focus on software developers and commercial applications for the technology. While Glass was never intended as more than a beta product, concerns around privacy and social acceptability have temporarily shelved widespread Glass adoption, providing a note of caution for automakers as they consider these technologies for widespread consumer applications. Despite a shift away from consumers, Glass development remains active in the enterprise space, creating an interesting scenario in which a consumer-focused technology has essentially been co-opted by commercial and industrial users.

The Future of Driving
Wearables will likely transform the way we interact with our cars, as driver and vehicle information can be shared in previously unprecedented ways. In addition to features such as remote access, navigation, vehicle service and nonsafety applications, there are several possibilities that can be explored from a health and safety standpoint. Clearly, wearables add a new layer of safety to automotive driving by extending the driver’s ability to monitor vital health parameters and take action in the case of an emergency (see Figure 3), as well as providing notification and information immediately and viscerally rather than relying on warning lights or chimes.

The biometric information from the driver’s Code Halo can be combined with the on-board diagnostics data (OBD) of the vehicle’s Code Halo to make driving a safer activity. For example, in a

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Scenario for Drowsiness Detection

Jeff is driving back home after his night shift.

- The built-in sensors — accelerometer, gyroscope and camera — of his Google Glass detect his drowsiness.
- The vehicle responds with voice and vibration alerts. Despite the alerts, Jeff continues to drive.
- The vehicle goes into the self-drive mode and safely steers him to a safe zone.
- The location-based service on his phone directs him to the nearest coffee shop for a break.

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Figure 3
precarious driving situation, phone calls can be blocked and a direct voicemail/text can be sent to the caller without disturbing the driver. Additionally, an impaired or ill driver could be detected, the vehicle safely stopped, and help summoned before an accident occurs.

We have developed a prototype called Tasuke (which means “help” in Japanese) that demonstrates how biometric information from the driver’s Code Halo could be combined with on-board diagnostics data to trigger action. For instance, data on the driver’s heart rate from his smartwatch can be combined with information on the speed, acceleration and maneuvering of the car and fed into an algorithm to gauge the driver’s stress level. If the stress level seems high, soothing music can be played to calm him or her down, or in extreme cases, more immediate action can be triggered.

While eyeglass- and watch-style wearables are currently the most common, a preferred form factor of wearables has yet to be determined, with manufacturers experimenting with smart bands, contact lenses, rings, etc., each of which may engender new possibilities. From an access control standpoint, biometric data (using smart bands such as Nymi™) can be used to replace current “smart keys,” storing a driver’s vehicle preferences, locking and unlocking the vehicle using biometric data, and starting the vehicle.

In the longer term, there is a possibility that wearables will be replaced by embedded sensors in the vehicle and human-implantable devices that accomplish similar results. A combination of all these devices could eventually reduce driver reliance on smartphones and dashboard electronics, with intelligent software determining the best way to notify the driver of information, based on driver preference and the criticality of that information.

Process Optimization in the Production Facility
The possible benefits of wearables for automotive manufacturers and their employees are even greater and much more immediate, and they are not dependent on consumer adoption of a particular technology. Wearables can increase employee efficiency, improve training and development, enhance communication, reduce rework and push informed decision-making to line employees, bringing about greater efficiency and transparency. Rapid adoption of this technology has caught the imagination of several independent organizations. In fact, the European Union is now co-funding a project called “WearIT® work,” whose main objective is to investigate the user and industry acceptance of wearables. The project focuses on building business cases and studying their tangible impact in association with several manufacturing companies.

For automotive manufacturers, there are immediate benefits for quality inspections, as well as for training and development. For instance, smartglasses (Epson Moverio, Oculus Rift, Vuzix®, Google Glass, etc.) can offer the wearer an immersive experience and be tailored for various operations and functions, such as playing context-aware instructional videos, live-streaming service and installation procedures and accessing troubleshooting expertise. Smartglasses could also be used to provide context-sensitive, semi-autonomous training to personnel that can even be delivered on-demand when an employee encounters an unfamiliar situation or requires assistance. Service and maintenance personnel can use smartglasses to access procedures and tips within or outside the factory.

A prototype implementation for training and development was conducted as part of the WearIT® work project in the Skoda production facilities in the Czech Republic. Several other companies are also working on use cases to deploy wearables on the shop floor. Plex Systems has developed a Google Glass prototype that can analyze and deliver details of a machine on the shop floor by just looking at it. Plex’s proof of concept allows an employee to view the status of the machine, add or remove inventory and see other relevant information. In the OEM space, large manufacturers like General Motors have tested several business cases for using Google Glass on the factory floor with approximately 100 employees in a controlled environment.
In the context of quality assurance, wearable devices can improve the efficiency of quality assurance personnel by providing quick access to standard operating procedures and enabling hands-free inspection, ultimately reducing the margin of error, as inspections generally involve mundane, repetitive and exhausting tasks. A prototype was developed to enhance the visual inspection and manual checking processes at the Skoda plant.

The benefits of using wearables in the production environment include:

- Error prevention.
- Faster and more efficient work.
- Enhanced communication through improved information-sharing.
- Shortened training processes
- Enhanced health and safety applications.

The aforementioned examples demonstrate how wearables can introduce efficiencies to automotive manufacturing by providing workers with easy access to context-sensitive, process-related information, when and where it is required. Like most current wearables applications, many of the capabilities are not necessarily in the device itself, but in defining a business problem and developing the supporting infrastructure to capture and deliver information to a user’s wearable device.

Challenges of Wearables Adoption

Although the benefits of wearables are numerous and multi-faceted, a wide range of challenges must be addressed before their complete potential is unlocked.
Device-level Challenges

Battery life is a key issue that limits the utility and efficacy of wearables deployed in various environments. Owing to its small form factor and proximity to the body, battery capacity faces several physical constraints. The battery must be small and long-lasting and should not overheat when used in long durations. These limitations constrain the display, communication and processing capabilities of the device, since all must be balanced against a demand for power that lasts through an average workday. Similarly, the user experience and design of the apps used with these devices must be tailored to optimize battery usage, while accommodating non-traditional screen sizes and interaction methods. Another option that several device manufacturers are exploring is the use of solar or kinetic (motion) energy, either as a component supplementing the battery or as an alternate source of power.

Data-level Challenges

With the advent of smart devices aided by high levels of connectivity, large volumes of data are associated with these devices. Organizations should build a robust back-end cloud infrastructure with adequate security measures in place to deal with such a magnitude of data. Traditional IT approaches and integrations may not be able to handle the volumes of data associated with wearables, and even if wearables are not currently on a company’s roadmap, investigating technologies like cloud computing and API-style interfaces will prepare the business for wearables and future technologies.

Integration Challenges

Although individual devices have their own operating protocols, interoperability among different devices in the IoT ecosystem is proving to be a challenge because of the lack of common standards, although several industry players are attempting to define common standards or middleware-type platforms that allow disparate devices to intercommunicate.

Equipping a significant number of workers with interconnected devices puts an additional strain on IT infrastructure, both from a technical and managerial perspective. If employees that once carried a smartphone and laptop now carry an additional half dozen devices, traditional methods for managing IT resources become increasingly untenable.

Current wearables also have very limited processing and storage capabilities, requiring much of the processing and data that enable their functionality to be performed on another device. This may put additional strain on internal IT resources, or necessitate increased use of cloud-based resources to handle the device load.

Behavioral Challenges

Technology initiatives typically struggle to gain acceptance among employees who don’t understand how the technology immediately benefits them. It is, therefore, important that organizations help employees understand how the wearable device will help them perform more effectively and efficiently, or make their job easier or more pleasant. As employees become more familiar with wearables in the consumer space, this equation may change, mirroring smartphone adoption, where employees demand a preferred device over a corporate alternative. However, until this shift occurs, businesses should be prepared to build a compelling case for wearables at the executive and end-user levels.

Consumer privacy concerns also need to be managed, as these devices are typically always-on and always-connected. Although consumers stand to benefit from sharing data, there can be some concern about the use of wearables, as many fear misuse of their personal information. In order to mitigate this concern, organizations must explicitly state that data-sharing will occur through an opt-in mechanism only, and be prepared to articulate their policies and controls around how consumer data is used in a transparent and readily understandable way.
Another concern is information overload — that devices will emit too many unnecessary alerts or an overwhelming number of notifications, causing them to be perceived as more of a nuisance (or even a danger) than a productivity aid. A recent TechCrunch review of the new Android Wear smartwatch bemoaned the fact that the device alerted users with every new text, e-mail and calendar item. It ultimately became a distraction — the very last thing a driver needs.18

**Regulatory Challenges**

The use of wearables in cars — particularly eyeglass-style devices — is highly controversial, and many governments have prohibited their use for safety reasons; legislation banning eyewear exists in several U.S. states and in the UK. However, recent cases have been dismissed on the grounds that it could not be proved that the device was switched on or that a distracting or invasive application was being used.

In our view, the device itself should not be banned, but certain distracting use cases (such as watching videos) should not be available in certain situations, like when operating a vehicle. Eyewear that functions as a dashcam, displaying a blind spot or emitting a collision safety alert, will contribute to safer driving, not deter it.

**Looking Ahead**

We recommend the following steps for automotive companies seeking to integrate wearables into their processes:

- **Step 1: Apply Design Thinking**

  > **Conduct envisioning workshops with a wide cross-section of employees.** As wearables are an emerging technology with few proven use cases, automakers should plan to build a small working group that includes factory employees, marketing executives, production engineers and IT staff. Focus on the intriguing capabilities of wearables, such as ubiquitous connectivity and augmented reality, and explore use cases where these capabilities could create compelling benefits. A few easy candidates should emerge from processes that currently use smartphones or tablets; however, avoid being constrained solely to these scenarios.

  > **Conduct process assessment and re-design to build business cases for wearables.** With a handful of use cases identified, enterprises should assess the related processes and ultimately identify a shortlist that can be tested with a limited wearables pilot. These can also be used in typical scenarios where users could benefit from instant information but are constrained by a prohibitive environment. Use cases should also validate the use of wearables vis-à-vis smartphones, tablets, etc.

- **Step 2: Pilot and Scale**

  > **Conduct a pilot project.** A proof of concept is needed to see how the idea performs before it is funded and implemented (as was done with WearIT@work). A sample user group should be selected to participate in a pilot study, ideally including actual users, managers and IT staff. The group will need rudimentary training on the objective of the study and should be observed in a controlled environment.

  > **Scale and engage stakeholders.** The outcomes of the study should be analyzed, the benefits quantified and a business case built around the proposed project to drive widespread adoption. Adequate training and sup-
port should be given to all stakeholders to ensure acceptance. The idea is to start with small-scale, limited implementations, and iterate on a rapid and frequent scale, allowing for near-term successes and increasing value in the long run.

• **Step 3: Enable Agility**
  
  ▶ **Plan for iterative use case refinement.** Periodic checkpoints should be established, and feedback should be collected from users and data produced by the platform. Periodic technology and market scans should be performed for new wearable devices that better fit the operational context.
  
  ▶ **Embrace a spirit of collaboration and partnership.** Adoption of wearables should also be driven by widening the partner network and improving collaboration with various stakeholders in the ecosystem, ranging from device manufacturers and extending to the developer community.

Wearables have immense potential to disrupt the automotive industry by ushering in new possibilities. While these technologies remain unproven in the enterprise and consumer markets, their potential for differentiation and competitive advantage provides a compelling case to innovate in an industry where products are increasingly perceived as similar. Even if wearables are not immediately usable in an organization, planning for the organizational and technical changes required to support them will prepare the enterprise for rapid adoption as the technology matures.

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**Footnotes**


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