Wearable Tech: Leveraging Canadian Innovation to Improve Health
Authors

Hadi Salah, Industry Analyst, Life Sciences & Healthcare, MaRS Market Intelligence
Emily MacIntosh, Market Research Analyst, MaRS Market Intelligence
Nirusan Rajakulendran, Market Research Analyst, MaRS Market Intelligence

To download the original report, please visit www.marsdd.com/news-insights/mars-reports/.

For further information, please contact Hadi Salah at hsalah@marsdd.com.

Disclaimer: The information provided in this report is presented in summary form, is general in nature, current only as of the date of publication and is provided for informational purposes only.

MaRS Discovery District, ©March 2014
# Table of Contents

Quantifying life: The rise of the Quantified Self movement  

Wearables  
- What are wearables?  
- A brief history of wearables  
- Applications: Wearables for health  
- Table 1. Incumbents: Wearables for health  
- Health and wellness wearables: Benefits  
- Benefits to physicians and other health providers  
- Benefits to health payers  
- Benefits to patients  
- Health and wellness wearables: Shortcomings  
- Target customers  

Market landscape: Global market for wearables  
- Market segments  
- Wearables for fitness and sports  
- Wearables for medical and health  

Canada’s wearables startups and innovators  
- Startup profiles  
- Researchers  
- Startup challenges  
- Manufacturing  
- Value proposition  
- Design and style  
- Privacy  

Investment snapshot  
- Investor profiles  

The future of wearables  
- Predictive guidance  
- Multiple functionalities in a single device  
- Wearables as a platform  
- Many losers, few winners  
- Prices drop, new business models emerge  

References
Quantifying life: The rise of the Quantified Self movement

Quantified Self, also known as lifelogging, is the use of technology to capture, measure, track and analyze data from a person’s daily life. The types of data that can be captured and tracked are infinite in number, and the data collected are unique to the individual. For example, it could include environmental data to understand ideal temperatures for personal comfort, one’s calorie intake in a day, the amount of exercise had, or the number of tries it took to learn a new process.

Although the inception of the Quantified Self movement can be traced back to Gary Wolf and Kevin Kelly of Wired Magazine who coined the term in 2007, humans have been tracking their activities for decades, even centuries. One example is Benjamin Franklin who, in his autobiography published in 1791, described tracking 13 personal virtues in a daily journal and marking his progress in 13 different charts, one for each virtue. Franklin’s motivation in quantifying this was to monitor self-improvement and to accomplish his ambitions.

That is what Quantified Self is all about. Tracking ourselves enables us to understand such things as why we gain weight, how we learn, what irritates us and what makes us happy. This leads to greater self-awareness, which can spur us to improve the status quo. What has changed over time is how we track our data. Instead of pen and paper and journal entries, technology has rendered tracking metrics simpler and automatic. Our repertoire of Quantified Self tools is large and continues to grow—from straightforward software and mobile apps to devices such as smart scales to wearables that are continuously worn by the user.

Users tend to use software tools, apps and devices intermittently, recording data when they feel like it. It’s an inconsistent and possibly biased approach. In contrast, wearables have exploded onto the scene in the last year mainly due their continuous and automatic tracking functionality, helping Quantified “Selfers” log their metrics with minimal effort. This whitepaper explores wearables as an emerging technology, with an emphasis on how it may impact health and wellbeing.
Wearables

What are wearables?

Wearables are small electronic devices, often consisting of one or more sensors and having computational capability. They are embedded into items that attach to the body, such as a user’s head, feet, arms, wrists and waist. They can resemble a watch, eyeglasses, clothing, contact lenses, shoes or even jewellery. Wearables either capture data or present data. The types of data collected could be as simple as the number of steps taken in a day or as complex as ECG or brainwave measurements (Figure 1). For output, wearables can convey information to the user through a variety of means, from the blinking of an LED light to a complex display of data.

Figure 1: Incumbents: Examples of wearables, their location on the user, and sample data collected.
Wearable computers have been around for several decades. Two early pioneers are Georgia Tech’s Thad Starner, and Steve Mann. Starner strongly advocated the potential of wearable computers while completing graduate work at MIT and later working as a technical lead/manager on Google’s Project Glass. Mann is often described as the “father of wearable computing” for building a head-mounted computer device as a high-school student in the 1970s. Mann currently researches wearables at the University of Toronto.

Credit is also due Ed Thorpe and Claude Shannon, who invented a cigarette pack-sized pocket computer that was designed to predict roulette wheels in the early 1960s—one of the first wearable computers. Later that decade, Hubert Upton, while working on a personal project, invented eyeglasses that were designed to aid with lip reading for hearing-impaired individuals. This exemplified the potential health and wellness application of wearable technologies. Since the 1970s, the miniaturization of components, the switch to digital from analog, superior computing power, better battery technology and capacity, the incorporation of wireless connectivity and reductions of overall costs have resulted in an eruption of new products entering the market. In 2014, at the Consumer Electronics Show (CES) in Las Vegas, wearables emerged as a top trend, with new product announcements from most major electronics companies, and new startups covering a plethora of applications, with health and fitness being a key category. A brief summary of notable events related to wearables is shown in Figure 2.
A brief history of wearables: Figure 2

**1960s**

Ed Thorpe and Claude Shannon invented a cigarette pack-sized pocket computer that was designed to predict roulette wheels. The device was easily concealed in a shoe.

**1970s**

HP releases the HP 01 calculator watch.

**1980s**

Steve Mann builds the WearComp1 - a backpack-based system capable of displaying data on a head-mounted micro display and wireless communications.

**1990s**

Steve Mann developed the “Wearable Wireless Webcam”.

**2000s**

First generation iPhone is released, revolutionizing pocket computing.

**2010s**

A plethora of consumer wearables hit the market, including Nike FuelBand, Fitbit, Google Glass.

**Sources:**


Applications: Wearables for health

Health and fitness, and other medical applications, are areas where wearables are expected to play a transformative role. However, the application of wearable devices has potential in any industry where hands-free data collection is highly valued. Wearables can be generally divided based on consumer or non-consumer applications. These two categories can be further segmented based on the particular sector the product targets.

The consumer market segments for wearables include: 6

- General consumer
- Fitness and sports
- Fashion and apparel
- Home automation and remote identification
- Gaming and recreation

The non-consumer market segments include: 7

- Defence and security
- Enterprise and industrial
- Healthcare

Wearables for health (including fitness, wellness and medical applications) are some of the early applications that have already gained traction. Notable examples are shown in Table 1. Their success so far is not a surprise, as they have already shown clear benefits to the user in a number of ways.
## Table 1: Incumbents: Wearables for health

<table>
<thead>
<tr>
<th>Product</th>
<th>Function</th>
<th>Price Point</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nike</strong></td>
<td>All-day activity tracking of calories burned and steps taken. Activity is quantified using “Fuel”, a metric developed by Nike as “a single, universal way to measure all kinds of activities”</td>
<td>$150–$170 USD</td>
</tr>
<tr>
<td><strong>Jawbone</strong></td>
<td>Track steps, calories burned, distance covered, pace, active vs. inactive time, and sleep quantity and quality</td>
<td>$130–$150 USD</td>
</tr>
<tr>
<td><strong>Fitbit</strong></td>
<td>Tracks steps, distance covered, calories burned, floors climbed, and sleep quantity and efficiency</td>
<td>$60–$130 USD</td>
</tr>
</tbody>
</table>
Health and wellness wearables: Benefits

An array of potential benefits stems from the use of wearable devices for health. These tools can be leveraged whenever information or communication is required, a hands-free interface is helpful and consistent monitoring is beneficial. Though wearables for health have not yet achieved broad, mainstream usage, one can already see the many ways in which they could benefit health providers, health payers, and individuals.

Benefits to physicians and other health providers

1. **Patient data for improved services**
   Wearables enable patients to capture health data that would otherwise go undocumented. This data can be captured as the patient goes about his or her day-to-day activities, rather than under the stress of a medical appointment. Physicians and other health professionals can then use this newly available data to improve the diagnosis, treatment and management of various illnesses, effectively increasing the quality of the services they offer.

2. **Hands-free for efficiency in sterile/aseptic environments**
   The hands-free nature of many wearable devices is beneficial to health professionals working in sterile environments because, when worn, they preclude the need for surface sterilization. For instance, in an operating room where hand washing is required, physicians and other staff can use Google Glass to continuously receive information throughout surgery without needing to use their hands. Enabling multi-tasking through hands-free information or communication also assists these professionals by increasing work efficiency.

3. **Training and collaboration from the first-person point of view**
   Wearables with video and audio capability will enable unique new training and collaboration opportunities for medical professionals. Users will be able to film procedures as they are performed, creating extremely effective first-person point-of-view medical training materials. Additionally, wearers can connect to other professionals, creating the opportunity for real-time collaboration (e.g., with specialists) during procedures, potentially improving patient outcomes.
Benefits to health payers

1 Wearables as levers to improve plan members’ health (and thereby decrease costs)

Insurers and corporations are looking to wearables as tools to improve plan members’ health and thereby reduce costs. Insurers such as California’s Blue Shield have offered incentives such as reduced premiums to plan members who use their specified wearable and demonstrate improved activity. Other insurers have focused on incentivizing the use of wearables through point-based reward systems, or cash. Similarly, some corporate wellness programs include wearables as a means of tracking daily activity as a part of group competitions or other motivational programs. Regardless of the incentives chosen, these programs demonstrate the clear cost benefit of using wearables to improve plan members’ health.

Benefits to patients

1 Improved health outcomes through sustained motivation

It’s long been known that measurement (of both a baseline state and progress) is a key component to improvement. The same applies to health, with even basic pedometers showing a measurable impact through better health outcomes. Consumers find tracking their exercise and other health data motivating. In a survey, 52% of wearable owners indicated that they primarily use their devices to stay motivated. Keeping track of accomplishments and seeing them visually represented inspires users to continue pursuing their goals. Forrester Research found that with wearables incorporating techniques such as gamification, social sharing and digital coaching, it “make[s] it easier for people to go to the gym every day.”
Ease of data collection
Wearables for health will likely be attractive to individuals wishing to track their vital signs and other metrics throughout the course of their day or particular activities. The concept of Quantified Self is gaining in popularity and wearable devices have automated the data collection. Rather than focusing on estimating, measuring, documenting and calculating individual metrics at particular points in time, users can simply put on a wristband (or other) device. With this ease of data collection, users can acquire more data across broader timeframes than could be achieved manually.

Highly accessible technology
With many devices’ price points landing around the $100 mark, wearables for health are affordable tools, accessible to many. The declining cost of sensors and other components, combined with economies of scale, will ensure that the price of wearables continues to decrease as their popularity increases.

Better care
Wearables, whether used by the patient or the health professional, have the potential to improve medical care. In addition to the benefits that health professionals can leverage in the delivery of care to patients, wearables can also benefit the wearer by helping them better quantify their health and communicate it to their healthcare providers. Consumers’ newfound ability to track and share their own health data is also effectively democratizing medicine, allowing patients to take control and demand better care.

Health and wellness wearables: shortcomings

Accompanying wearables’ potential benefits are some current shortcomings. As a new technology, these tools require further refinement before they are ready for broad, mainstream adoption.

Unaddressed regulatory and policy issues
The regulatory requirements for medical devices are well established worldwide, but new wearables are not required to play by the same rules. Wearables are designed to capture personal data and transmit it for analysis or sharing, but little has been established with respect to responsibility for when that information lands in the wrong hands. These new technologies are operating in a regulatory and policy grey area. MIT Technology Review has already highlighted the issue: “As everything from glasses to watches to thermostats become Internet-connected, those gadgets become vulnerable to malware and other security and privacy issues.” As the wearables space rapidly evolves and policy issues emerge, consumers will likely look to government to establish roles and responsibilities relating to matters such as privacy, security, data ownership, and consent.
Health and wellness wearables: Shortcomings

Technical difficulties
As with many new technologies, wearable devices are facing hardware and software issues that may hamper widespread adoption. The incorporation of sensors and computing power into ever-shrinking devices designed to be worn on the body present physical challenges. A common concern is water-proofing, since sweat or washing can introduce damaging moisture into the wearable. Additionally, the devices' compact size can result in constrained power reserves or frustratingly small screens and displays. Hardware issues have already been observed in the market: in 2011, Jawbone's UP product experienced circuit board problems that impacted charging, data collection and, at times, overall function.

Poor data quality
While the performance and functionality of the sensors are key factors for health and fitness applications, they are of critical importance for wearables classified as medical devices. These products risk a recall by the U.S. Food and Drug Administration (FDA) and/or Health Canada if they provide inaccurate readings. Some wearables currently on the market have produced noticeably incorrect data, leading consumers to question the utility of the devices. One product that has generated this type of user complaint is the Nike+ FuelBand, which “undercounts or overcounts certain types of activity.” Companies must focus on improving data quality to ensure next-generation devices meet consumers’ expectations.

Unwillingness to deliver insights, interpretation or coaching
Continuous tracking of one's activities generates a large volume of data in a short period of time. This data only becomes valuable though once it is “stored, managed, normalized, and interpreted” for (or by) the user. Providing these insights and coaching could, however, be interpreted as medical advice and thus the product would enter the medical device space. Often, consumer-focused wearables are wary of moving into this area due to stringent industry regulations. As a result, “the user has to do a lot of work” to overcome the existing “lack of actionable context.” Many wearables continue to bypass the development of robust guidance or coaching to avoid being classified as a medical device, and consumers are likely not achieving their potential because of these business choices.

Impracticality of device designs
Growing evidence shows that up to one third of consumers who purchase wearables stop using the devices within six months. This is likely related to the impracticality of device designs, as consumers have expressed strong interest in how devices feel when worn. The use of wearables may simply prove too awkward and unworkable for broad adoption. Beyond the “feel,” users are also likely concerned about social acceptance: “wearing a screen to the right of one’s nose may appear a little strange,” and “making odd, random gestures, pointing, jabbing, plucking, and talking [to oneself]” are not yet part of expected social behaviour. With time, however, these activities may become as accepted as our commonplace use of mobile phones and other technologies.
Unfashionable designs
Though efforts are underway to counter this, many existing wearables are not attractive devices. ZDNet (a leader in IT news and analysis) went as far as to call many devices “ugly” and noted that “tech companies aren’t always the best purveyors of fashion.” Other descriptors of wearable design have included “clunky” and “dorky.” Consumers prefer products that do not look like devices, or at least have “the design aesthetics of a company like Apple.” As Frost & Sullivan emphasized, “the more aesthetic elements (e.g., branding, design, and comfort) of consumer goods need to be given serious attention if tech companies are to achieve mainstream adoption among consumers.”

The cost of inactivity
This drawback is directly related to the healthcare payers’ usage of wearables. If these devices can show an individual’s health and fitness efforts and reward them accordingly, then the devices can also be used for the opposite purpose. As Forrester Research concluded, “as fitness wearables track the activities of more and more employees, for-profit healthcare systems will both reward adherents to an active and healthy lifestyle ... and punish non-adherents.” Although the shift to more personal responsibility for one’s health may seem generally positive, it could also prove detrimental to those who, for one reason or another, cannot achieve the activity benchmarks defined by payers.

Preying upon human insecurity
Humans have survived on this planet for thousands of years without the need for modern wearable technology. History shows that humans do not require these tools in order to be healthy, yet consumers are still motivated to purchase them, likely due to worries about health and mortality. It is important to recognize the drivers behind different wearable applications – and to address these with the best of intentions.
Target customers

As relatively new products, wearables are generating initial interest among a select group of consumers and health professionals. The demographics of the target consumer are summarized in Figure 3.

**Figure 3: A typical target customer for wearables**

- **CURRENT DEVICE OWNERS**
  - Average age of 36 on the contrary analysts are also predicting expected future shift: Baby Boomers
  - Nearly equal interest from males & females
  - Higher household incomes than average consumers
  - Likely to already own a smartphone: Open to new technology & applications
  - Health status and interest:
    - Healthy and health-conscious
    - Unhealthy, but striving to be healthier
    - Regular consumer of organic or natural products & likely to exercise in spare time

- **FUTURE DEVICE OWNERS**
  - More women buying wearables
  - As prices decrease, income will not be a predictive factor
  - 25 to 44 years old in range

Tom Emrich, a wearables expert and super user, puts it well:

“As we see more fashion come into play, this may become one technology that’s used more by females. A lot of [wearables] are considered jewelry. If devices become more fashionable, it’s a women’s market.”

Specialists and professionals

Currently, the majority of wearable devices are consumer-targeted products. As the market matures, it is expected that new uses will emerge for existing devices (e.g., viewing patient vitals on Google Glass during surgery), and that new devices will be developed specifically for certain professions (e.g., PUSH for sport scientists). Some potential applications for wearables in health professions include surgical assistance, medical training, diagnosis and patient monitoring. Due to the diverse potential applications, healthcare has become the largest non-consumer segment for wearable technologies.

Professional early adopters are likely to be similar in profile to consumer early adopters: well-educated, high-earning Gen-Xers who are open to new technology. However, despite choices by the early adopters, products that can provide (and scientifically demonstrate) the most benefit in relation to cost are likely to be the ones purchased at the institutional level in healthcare. Adoption of certain technology by hospitals, research centres or universities will ensure that the selected devices gain a demographically broader user base.
Market landscape: Global market for wearables

As noted, the wearable devices market has grown dramatically over the past few years as advancements in electronics, material sciences and sensor technologies have allowed innovative startups to create relatively inexpensive devices. Other drivers, such as consumer interest in personal health and fitness, have helped to propel this market forward.

Consumers have responded with their wallets. For example, Pebble has sold about 190,000 units, Samsung sold over 800,000 units of their SmartWatch in just two months, and Nike has sold between one to two million FuelBands.

The market for wearable devices is both broad and varied. These devices range from simple wristwatches that count calories (like the Nike Fuelband) to continuous glucose monitors (like the MiniMed Paradigm® from Medtronic) to heads up display, or HUD, monitors (like SNOW2 from Recon Instruments). Manufacturers are developing creative ways to fit these devices on and with the human body. This market is poised to accelerate over the next few years as innovative ideas come to market and consumer interest and knowledge grows.

Initial estimates by market research firms confirm the growing interest in this field. However, the numbers vary as analysts work to grasp this evolving market. For 2014, sales estimates by research firms ranged from less than 50 million units to more than 200 million units annually. Looking ahead to 2018, ABI forecasts that annual shipments will increase to 485 million units. In contrast, MarketsandMarkets, another research firm, predicts that by 2018 the total shipment of wearable electronic products will expand to 134 million units.

In terms of global revenue, market research estimates range from $4.65 billion to $9.17 billion. Firms varied greatly in their projections for 2018, ranging from a conservative $6 billion to an optimistic $30.2 billion. (Figure 4)

Figure 4: Estimated range for the wearables market 2014-2018
The wide disparity in market numbers shows that industry experts are still uncertain about the wearable technology market. Some analysts believe that consumer interest in this market is overinflated and that it will take some time for interest to grow. JP Gownder, Vice President and Principal Analyst at Forrester Research, believes that “…the wearables market is, in fact, suffering from a bit of a hype bubble.” In his blog, Gownder draws a comparison to the early days of the internet, when there was a lot of early hype although most of the expectations were only realized after a decade or so of growth. In order for manufacturers to translate “hype” into sales, they must focus heavily on educating their consumer base on the true benefit of a wearable device. A recent survey conducted by IDC affirms a similar message that consumers are still unsure about the true value proposition of wearable devices.

Market segments

Consumer applications are the largest component of the overall market. BCC Research published the most comprehensive study on the topic, projecting the market to grow from $6 billion in 2014 to $22.1 billion in 2018. The non-consumer market accounts for the rest: $3.2 billion in 2014 and $8.1 billion in 2018 (Figure 5).

Figure 5: Market size for consumer and non-consumer applications by application and region, 2014-2018
Fueled by the Quantified Self movement, wearables for fitness and sports have captured the attention of enthusiasts and consumers alike. Wearables for this market sector measure data such as heart rate, step count, calories burned, breathing rate, balance, explosive strength, and much more. These devices are generally simple in form and function and are marketed towards professional and amateur athletes, coaches, parents of athletes, and health-conscious consumers. Customers are interested in fitness devices like the Fitbit Flex and the Jawbone UP because these tools help motivate users to realize personal goals such as maintaining a healthy weight and getting the proper amount of sleep. These devices help consumers gain a deeper understanding of their own body and, in the process, recognize the necessary next steps to improve their overall health.

The fitness and sports segment is currently experiencing fierce competition as companies like Nike, Jawbone, Fitbit, Philips and Samsung battle for space. The total market size is summarized in Figure 6.
The potential applications of wearables for medical and health purposes are vast. For the patient, a wearable device can collect information on heart rate, brain activity, sleep patterns, glucose levels, blood pressure, stress levels and more. And such a device enables better sharing of insights with physicians and/or caregivers. For example, the BodyGuardian Remote Monitoring System® by Preventice® is a wearable cardiac sensor that allows physicians to monitor patients’ biometric signals. This FDA-approved device monitors non-lethal arrhythmias in ambulatory patients and delivers this information wirelessly to healthcare professionals. Wearable devices are opening the door for physicians to oversee and deliver care outside the clinic.

Physicians and other healthcare workers are also experimenting with wearable technologies in their practice. As an example, Dr. Pierre Theodore, a lung surgeon and assistant professor of surgery at the University of California San Francisco, is currently using Google Glass in the operating room. Glass is a wearable device with a head-mounted display that allows users to record and view videos and images, browse the web, and run third-party applications. Dr. Theodore uses the device to view pre-loaded X-ray and CT scan images while performing surgery. For Dr. Theodore, Google Glass allows him to focus on the patient at all times and not leave the operating room or switch to another system in order to view medical images.

Wearable devices used for medical and health purposes are often relied upon to provide vital information and thus assurance about accuracy and reliability is critical. In most cases, wearables used in a clinical setting must receive approval from a regulatory body. These devices generally provide a greater level of accuracy over fitness devices and are customized to meet the needs of the healthcare provider and patient.
Healthcare is currently the largest market segment in the non-consumer application of wearables. (Although by 2018, it is predicted that the enterprise and industry market segment will take the lead.) The global healthcare market revenue for wearable devices is estimated to reach $1.1 billion in 2014 and grow to $2.9 billion by 2018. The majority of revenue for this market segment (as seen with fitness devices) will come from North America (52%), followed by Europe (26%), Asia-Pacific (16%) and the rest of the world (7%).

The total market size for medical and healthcare wearables is summarized in Figure 7.
Canada’s wearables startups and innovators

In Canada, the wearable device startup and researcher ecosystem is thriving. World-class startups have emerged in recent years from different corners of the country, with clients across the globe. Leaders in this industry are profiled below.
Airo Health began as a University of Waterloo project and then spun off into a startup. Leveraging the Velocity Garage mentorship and resources, the two founders began developing AIRO. This wearable, described as “one band for all your health goals,” is intended to help users manage and control the four pillars of one’s health:

1. Quality of diet  
2. Effectiveness of exercise  
3. Management of stress  
4. Nature of sleep

**Target customer**  
Airo Health is targeting its first product to health-conscious individuals between the ages of 18 and 56 who “want to live better and want to understand what’s going on with their own bodies.”

**Business model**  
For consumers, Airo Health is considering a “one-time price [for the wristband] with free online services.” Though post-procedure aftercare and other medically-focused markets are promising, the company has noted that the business model may need tweaking: “As soon as you move into the healthcare space, the stakeholders completely change. It’s almost a given that different business models will have to be used to traverse that territory.”

**Timing**  
With the growing awareness of health and factors that influence it, founder Naman Kumar feels that it’s “the perfect time to bring out a device that essentially gives [individuals] control over their own health. Wearable computing is the most convenient way for everyday folk to have access to this kind of a utility and facility.”
Toronto-based startup PUSH Design Solutions Inc. focuses on providing professional athletes with scientifically validated data so that they can maximize their strength-training exercises. Through the use of a wearable device and a mobile application, athletes can track fitness metrics such as reps and sets, force, power, balance, speed and explosive strength. The PUSH armband allows athletes to review their training and share their results with coaches, trainers and friends.

**Target customer**
The device is currently being marketed to professional athletes, trainers and coaches. PUSH wants to ensure that the product succeeds in the professional market, and then translate what they learn from the initial launch and scale the product for general consumers.

**Challenges**
One of the key challenges for PUSH was finding the right manufacturing partner to deliver their vision. Initially the company went overseas to find a partner–however, due to shipping delays, communication issues and turnaround problems, the company is now seeking local suppliers. In our discussion with startups across Canada, most felt that manufacturing and design were among the greatest challenges in this market.

**Startup environment**
Canada is home to a number of innovative startups that are gaining international attention. We asked PUSH CEO, Rami Alhamad, what he thinks of this growing interest in wearables in Canada. His opinion? “It’s absolutely fascinating to be honest. To think that we’re such a small country, relatively speaking, compared with our neighbours down south. And we are coming up with some of the leading wearable devices out in the market right now!”

---

**PUSH Design Solutions Inc.**

- **Funding:** $900,000
- **Revenue:** $150,000
- **Number of Employees:** 10-12
- **HQ:** Toronto, ON

- **Device:** PUSH
- **Application:** Fitness & sports
- **Body location:** Arm
- **Release date:** Summer 2014 (estimated)
- **Price:** $149.00 USD

**Founders:**
1. Rami Alhamad, 26
2. Mike Lovas, 33
3. Suresh Joshi, 29

---

Funding: 900,000
Revenue: 150,000
Number of Employees: 10-12
HQ: Toronto, ON

Device: PUSH
Application: Fitness & sports
Body location: Arm
Release date: Summer 2014 (estimated)
Price: $149.00 USD

Founders:
1. Rami Alhamad, 26
2. Mike Lovas, 33
3. Suresh Joshi, 29
Engage Biomechanics was founded in 2012 as a York University spin-off. The idea for the device stemmed from a chance conversation between two professors (the founders) and a nurse regarding common issues in the long-term care sector. The wearable under development is designed to prevent pressure ulcers, commonly known as bedsores. The device will detect the position, posture and motion of a bed-bound patient and will notify personnel when proactive intervention is required. In the future, Engage Biomechanics intends to launch additional wearable technologies to aid in elder care, such as devices to help prevent falls and manage wandering.

**Business model**
To appeal to institutional buyers, such as hospitals and long-term care homes, Engage Biomechanics is considering a subscription model. “We may not charge for the device upfront, but instead have a monthly subscription that includes the device, the maintenance and the SAP subscription.”

**Importance of partnerships for device development**
Mirvise Najafe, VP of Operations, emphasized the importance of strong relationships with healthcare facilities. He notes, “We work with them hand-in-hand to ensure integration with their systems. The partnerships that we build are a solid component to [our device] being a plausible solution.”

**Future of wearables**
Engage Biomechanics believes that, in future, single data sets will offer limited value and that instead the focus will grow into “predictions of certain events, or longer-term insights, both of which stem from an integration of multiple data sets.”
In 2010, Danny Crossman and Scott Clark founded Impakt Protective, building upon helmet-based sensor technology that Crossman had developed for the military several years earlier. The company’s first product, Shockbox, is a miniature sensor that is placed inside helmets. It is designed to measure the magnitude and frequency of impacts to the head during sports. Its companion app then alerts the wearer if their brain has undergone an impact that would put them at risk of concussion, prompting them to remove themselves from play and seek medical attention. Impakt Protective’s next wearable, Playbox, will leverage sensors to measure sports performance.

**Target customer**
The Shockbox product is aimed at team sport coaches, trainers, and (depending on the wearer’s age) the player or their parents. Impakt Protective has already had success selling their devices to organizations. Crossman explains, “We’ve got whole hockey leagues in Toronto using them. Alberta high-school football organizations are using them. We just signed a contract with the Moscow hockey federation so every eight- to eighteen-year-old in Moscow playing hockey will be wearing Shockbox.”

**Challenges**
Crossman points out that some Shockbox marketing challenges stem from the fact that “traditional team sport is fairly old-school: it’s not a technology-rich environment.” His view is that it is likely easier to sell to individual athletes (such as skiers, runners and cyclists) who are more familiar with using sport technology.

**Future of wearables in sport**
In the future, Impakt Protective believes certain wearables will be required for particular sports. Crossman notes, “Look at things like neck guards and hockey: you have one NHL instance where somebody got cut in the throat and now every kid in hockey wears a neck guard. Helmet sensors for the head impact side will be regulated. It will be a mandatory addition.”
Toronto-based InteraXon is the creator of Muse: the brain-sensing headband. Muse is a brain fitness tool and wearable device that consists of a lightweight headband with seven EEG sensors designed to detect and measure brain activity, just as a heart monitor measures heart rate. The user’s brain activity is converted into audio and visual feedback that is displayed on a tablet or smartphone. With real-time information, users can understand how their brain is functioning and adjust their mind to achieve better results.

Target Customers
The target customers for Muse are individuals who are looking to decrease stress and improve cognitive function. Examples of customers include students who are looking to do better on their exams, parents with children who are looking to reduce stress, executives who want to be able to perform more effectively in the workplace and the elderly who are hoping to improve and maintain their cognitive function as they age.

Finding Talent
Acquiring talent is one of the most challenging aspects of running a startup. However, for InteraXon CEO Ariel Garten, identifying talent in Ontario was not a problem. “Many times people have asked me, ‘Oh, why don’t you go down to (Silicon) Valley?’” Garten explain, “And I respond with ‘no, there’s competition for talent in (Silicon) Valley, and here (in Ontario) we have very, very talented engineers and some of the best machine learning groups in the world.”

Startup Hurdles
For Ariel and her team, some of the challenges that they faced early include identifying a manufacturer, managing their inventory, and community management.
Toronto based startup Kiwi Wearables Technologies Ltd. focuses on solving problems for developers and builders in the wearable technology space. The company initially started with a development kit that allowed developers to stream raw sensor data in less than 2 minutes, and now has built up an open wearable technology stack that lets developers build applications without advanced knowledge of embedded electronics, kinematics or signal processing. The founding team has a blend of experience in design, software development, embedded systems, big data and general management consulting.

**Target Customers**

The target customers for Kiwi are developers, who are interested in prototyping, building and operating their personalized wearable technology applications. These individuals or organizations are familiar with rapid prototyping, 3D printers and basic web programming languages. In addition, Kiwi is also seeing significant market interest from B2B players. For both markets, Kiwi is working to ensure that a reliable and stable product is developed and shipped quickly to fully address their needs.

**Technology**

Kiwi is focused on developing open technology systems that incorporate privacy by design. The team focuses on using existing and scalable components to their solutions to ensure that they can be used as further down the value chain as possible by developers. Kiwi is also building technology that blends into a user’s daily lives by being significantly less obtrusive than the wearable devices available today.

**Developer Community**

Kiwi has a rapidly growing community of early adopters, who have purchased developer kits and provided feedback in addition to building innovative applications on the Kiwi platform which include 1) smoking cessation app 2) electronic pillbox and 3) soccer free-kick application amongst others.
Lynxio is the brainchild of Michael Vaughan, a recent graduate from OCAD University’s Industrial Design program. Lynxio’s vision is to create a knee brace that will empower patients and give them a greater sense of ability and freedom. To do this, Vaughan is working to create a device that will allow patients to track and record their physiotherapy regimen and share the results with their physiotherapist.

**Challenges**

Having a design background, one of Vaughan’s key challenges as an entrepreneur is learning how to run a business. Vaughan is actively looking for experienced business partners. In the meantime, he is leveraging resources at MaRS and OCAD University to launch his business.

**Passion and drive**

Entrepreneurs start a business for many reasons. For some, it is the challenge of creating something innovative. Others see it as a business venture and the opportunity to be financially successful. Asked about his motivation in creating Lynxio, Vaughan described that for him the appeal lies in “opportunities to keep people safe from themselves or from their environment, and in helping people get better quicker and more efficiently.”

**Market gaps**

There is a growing interest in the wearables market, although some gaps still need to be addressed to enable widespread adoption. Vaughan feels that current wearable prices are too high and that the devices are generally targeted toward consumers with disposable income. He noted that wearables need to provide intrinsic value to the customer, and that most consumers will not purchase them just because they are new and trendy.
Co-founders Roy and Fournier initially established their company in 2006, intending to perform critical analysis on health data. They quickly discovered that the devices to collect this data did not yet exist, so they set out to create their own wearable. The device, Hexoskin, is a shirt with fabric-embedded sensors, designed to be worn during a workout or throughout the day and night. This wearable is capable of monitoring heart rate, breathing, steps, calories, and more through its unobtrusive textile sensors. Hexoskin is used by the Canadian Space Agency and has been worn by medalists at the Sochi 2014 Winter Olympic Games.

Future of Wearables
Outside of the clinical environment, health data is scarce. The creators of Hexoskin want to challenge that: “Our job is to have millions of people wearing smart shirts for health monitoring. With this data we will learn how to help people with their health and prevent disease instead of just curing it” says Fournier. Ultimately, they hope Hexoskin “Changes the way medicine is practiced around the world.”

Current Gaps
Fournier expressed a lack of manufacturing capacity for components and materials for wearable health products. Despite the growing demand, Fournier believes that “there are no manufacturers that deliver the technology at the right price with the right quality.”

Data Ownership and Use
Data collected from Hexoskin is stored on the company’s servers, and is leveraged for research and product improvement. The founders feel that this storage option provides the most value to customers. However, the company recognizes that data is still owned by the customer because “People should have the right to own their health information.”
Stéphane Marceau and Frederic Chanay founded Montreal-based OMsignal in 2011. The co-founders had each become frustrated with elements of the health system, and were inspired to create a device to track and improve one’s own health. As a result, OMsignal developed a bio-sensing shirt intended to help users become their best and healthiest selves. The machine-washable smart apparel combines fit, compression, moisture wicking, and odor control into a single garment. Using the OMsignal shirt, individuals can track heart rate, breathing, steps, calories burned, and the unique OM index (relaxation/lack of stress).

**Application vs. Platform Focus**

OMsignal has elected to build a platform because the founders “Want to enable this data set and the applications surrounding it.” The company is planning to allow developers to create their own applications that leverage the data collected by the OMsignal shirt.

**Incorporating Predictive Features**

Marceau expressed that the machine learning and algorithms needed to add predictive features to wearables are already in existence. He said that the difficulty in incorporating these features actually stems from a lack of data: “The tough part is to get the dynamic data set in the cloud by getting millions of people continuously bio-streaming their data. The mathematics are easy once the data set is there.”

**Future of Wearables**

OMsignal believes that wearables (particularly connected clothing) will become ubiquitous and a baseline expectation. Marceau envisions that wherever a customer may shop, he or she “Won’t even ask and the clothes will be connected to the device that helps him or her live a fitter, healthier, happier life.”

---

**OMsignal**

**Funding:** $1.2M  
**Revenue:** Pre-revenue

**Number of Employees:** 18  
**HQ:** Montreal, QC

**Device Name:** OMsignal Shirt  
**Application:** Fitness and stress tracker

**Body Location:** Torso (Shirt)  
**Device Release Date:** Mid-2014 (expected)

**Device Price:** Not disclosed

**Founder(s):**

1. Stéphane Marceau, 44, CEO
2. Frederic Chanay, 43
Dr. Carolyn McGregor began her career in Australia, focusing on business- and finance-related information systems. She then shifted her focus to healthcare, establishing and growing the study of health informatics at the University of Western Sydney. Since 2007, Dr. McGregor has lead health informatics research in Canada. Her interest in wearables was partly inspired by work on the topic of neonatal critical care health informatics, where she encountered the problem that premature babies have fragile skin that can be damaged by the adhesives needed to connect monitor leads. Given their delicate nature, Dr. McGregor felt that neonates could benefit from gentler monitors that did not need to adhere, such as wearable sensors.

Data versus information in consumer-facing devices
Dr. McGregor believes that raw data has little value for consumers. “Those raw physiologic signals aren’t what I need—they don’t help me to understand how well I am.” She explains that “one of the challenges for a lot of these wearables is what to do with the data so it becomes information that creates value for the individual.”

Secondary uses of medical data from wearables
Though the public generally objects to its medical data being sold or used by corporations, Dr. McGregor asserts that other types of secondary uses are viewed positively. Her research has confirmed that “there’s a lot of public support for the use of the data as long as it is for not-for-profit or research or realization.”

Fostering innovation in wearables
Dr. McGregor highlights the need for a network connecting all parties involved in wearables for health. She notes that there should be more interaction between clinical experts and those who work on wearable technology. In her opinion, “creating some sort of structure that supports and offers cohesion between the different groups” would greatly benefit Canada’s burgeoning wearables industry.
The human body is an open canvas at the Social Body Lab. Located at OCAD University, the goal of the Lab is to find meaningful ways for humans to interact with technology. Director Kate Hartman leads a team of creative minds who tinker with technology and create innovative wearable devices. Hartman’s research and passion span a number of fields and include physical computing, wearable electronics and conceptual art.

Projects
The researchers at the Social Body Lab combine art, design and technology to address challenges and arrive at creative solutions. Some of the projects focus heavily on design, while others centre on practical ways to solve common problems. The Limber, a project that is currently underway is a system of wearable sensors that the Lab has created to reduce repetitive stress injury among knowledge workers. For details on Limber and other projects the Lab has underway, visit http://research.ocadu.ca/socialbody/projects.

Kate Hartman,
Social Body Lab, OCAD University

Research focus and approach:
Critical engagement with technology, interdisciplinary practices, meaningful interactions, distribution of knowledge, & collaboration.

Device-user interactions
The Social Body Lab aims to create devices that provide meaningful interactions. We asked Hartman to further elaborate on this concept. “The thing that we talk a lot about is whether technology contributes to or takes away from an interaction that you’re having. We have this proliferation of communication technologies, and in some ways it makes us more distracted, and in some ways it prevents us from really connecting with each other in a meaningful, satisfying, multi-faceted way.” The goal of the Lab is to investigate this idea further and find innovative solutions to connect humans and technology in a more meaningful way.

Future of wearables
When asked about her vision of the future of wearables, Hartman responded, “I hope that by that point, we’ll see wearables that are more integrated and more sophisticated, and less obvious. It’s my anticipation and hope that we’ll look a lot like how we look now, as opposed to some cyborg transformation. I see wearables ultimately bending to accommodate human interest and style rather than us going in some really sci-fi direction.”
Startup challenges

The wearable devices industry faces several unique challenges and hurdles that companies of all sizes must overcome if they wish to succeed. Through our research and discussions with investors, university researchers and Canadian startups, we have compiled a list of some of the key obstacles.

Manufacturing

Businesses in this industry are by nature hardware companies and thus encounter challenges that software companies do not. Most of the startups we spoke with cited manufacturing as a difficulty. For entrepreneurs, it is not easy to procure the many components that go into building a device. Finding the right manufacturer who is able to supply the components at the appropriate specification and quantity is sometimes the greatest challenge for an early-stage company. Startups in this industry also have to manage an inventory, which is often problematic due to limited working capital and uncertain consumer interest. Additionally, manufacturing and inventory logistics make it more complex for hardware companies to pivot their business.

Design and style

The style and aesthetics of the wearable device affects its chances of widespread adoption by consumers. Getting the overall look right is a major challenge. Ultimately, consumers want a device that is not socially awkward to wear. While the product must have a powerful processor and have a relatively long battery life, it cannot be intrusive and bulky to wear. Companies need to achieve the perfect balance between design and function.

Value proposition

To attract and retain customers, companies must demonstrate tangible benefits. Collecting health and fitness data has no intrinsic value unless it is presented in a manner that the customer can understand and utilize on a daily basis. As more and more devices enter the market and competition increases, selling a device that simply counts steps taken or calories burned will no longer suffice. To remain competitive and encourage adoption, hardware manufacturers must partner with developers to release value-add software apps that interpret and present body metrics in a meaningful way. If wearable device companies are not able to get developers to build apps for their products, their device will ultimately fail.

Privacy

Privacy and security is of paramount concern, especially with wearable devices that collect health and medical information. The recent privacy fears related to Google Glass have intensified this issue, and if the industry does not respond properly, consumer interest in wearables may diminish. Companies must clearly communicate to their target customers who owns the information and how the information will be used. In addition, they must ensure appropriate security so that devices cannot be tampered with or hacked.
Investment snapshot

Globally in 2013, wearables startups raised about $458 million across 49 investment deals, a significantly more robust amount than in 2012, when approximately $250 million was raised across 19 deals. Health wearables comprised a significant portion of that capital, accounting for about 30% of total money raised (or $136 million).

Figure 8: Capital raised for wearables in 2013
Investor profiles

Wearable Technologies AG

Founded: 2011
HQ: Herrsching am Ammersee, Germany
Recent investments in wearables: 4DForce GmbH, Thimble Bioelectronics and SportsCurve GmbH
Investment stage: Early-stage companies
Partners: Christian Stammel, Harry Strasser

Based in Germany, Wearable Technologies AG (WT AG) is an early-stage investor in the wearable technologies market. In addition, the firm hosts one of the world’s leading innovation competitions in wearable technology (Wearable Technologies Innovation World Cup), provides strategy and technology consulting services and hosts international conference and trade show.

Startup challenges
Florian Schumacher, a trend scout at WT AG and the founder of Quantified Self Germany, believes that the greatest challenge for startups in this market is that many “underestimate the difficulties of manufacturing a wearable device. That’s why we’ve seen so many startups either fail with their first generations, their first production batch, or in estimating the effort [needed] to get the whole production done.”

Future of wearables
Schumacher expects that over the next few years, three separate groups of consumers will emerge in the wearables market: a) Low-tech consumers; b) general-purpose consumers; and c) pro-consumers.
Daniel Debow is a Canadian entrepreneur and angel investor. As an entrepreneur, Daniel co-founded Workbrain, workforce management software, and Rypple, a social performance management platform – both of which were targets of acquisitions. Currently, Debow is Salesforce.com’s Senior Vice President, leading marketing for the group and re-branding the human capital management products under the name Work.com. As an active angel investor, Daniel is motivated to foster the tech ecosystem in Ontario by making many smaller seed-stage investments.

**Funding a Start-up Through Pre-orders**

When asked about pre-orders, Debow expressed that they can be “An enormously smart move,” for start-ups, particularly for those with significant hardware production costs, such as wearables. He commented that this appeals to him as an investor because it “Takes away a significant amount of revenue risk.”

**Social Adoption of Technologies**

Discussing the adoption of new wearables, Debow emphasized that society has greater impact on usage than the devices’ technical capabilities. Referencing *Diffusion of Innovations*, he stated, “The issue is not just about the technological adoption, it’s the social adoption. People need social proof, they need proof from other individuals.” Daniel emphasized that entrepreneurs can overcome this challenge partly by selling to specific vertical uses.

**Co-Founded:** previously founded Workbrain and Rypple

**HQ:** Toronto, ON

**Recent Investments in Wearables:**

PUSH, Thalmic Labs, Bionym

**Investment Stage:** Seed

**Partners:** N/A
Based in Toronto Ontario, Round 13, is venture capital firm that is focused on investing in innovative technologies in the information, communication and entertainment (ICE) industry, and have expressed interest in wearables. The firm is currently raising capital and will start investing in companies later this year.

**Investment opportunities in wearables**

Scott Pelton, a partner at Round 13, believes that the market for wearables is very lucrative with potential for growth. In terms of investment potential, devices that are able to collect multiple health and fitness metrics and provide some level of interpretation are the most attractive.

**Advice for Startups seeking VC funding**

There are a number of things that startups in this market can do to increase their chance of securing VC funding. When approaching a VC, Scott advises that startups should have a good understanding of the size of the market, and whether they will be manufacturing the device locally or overseas. In addition, Scott states that companies in this market should have a good understanding of how much working capital is required to run the business. Scott also believes that a perfectly executed crowdfunding campaign can greatly help startups secure follow-on funding from VCs and other investors.
Mistral Venture Partners is a VC firm that focuses on investing in early stage companies in the Internet and mobile sector. The firm is hands on and works closely with their portfolio companies to provide operational guidance and business expertise. Their ongoing support and international network means that early stage companies are able to accomplish milestones faster and with less capital.

Start-up challenges
Code Cubitt, Managing Director at Mistral Venture, explains that one of the major challenges for start-ups in this space is the sheer complexity of designing a device that requires multiple fields of expertise. Companies in this space often require experts from diverse fields like human physiology, fashion, textile, programming, and engineering and often it is a challenge trying to get all of these different areas to come together and collaborate.

Due-diligence
Cubitt emphasizes the need to have an excellent IP strategy in place, prior to seeking funding from a VC firm. Cubitt explains that the wearables market is becoming incredibly competitive and crowded, and expects to see a “wave of litigation” in the next few years. For investors, a key component of their due diligence is determining if there are any patents that limit a company’s freedom to operate.
The future of wearables

This report was researched using secondary resources and published studies. We also interviewed more than 20 stakeholders: investors, startups, academics and users. Secondary research reveals that wearables have been around for years. They hold tremendous potential to impact user’s lives in terms of their health, how they interact and communicate, and how they accomplish tasks and track data. The wearables market is expected to reach the billions of dollars. But what lies ahead? The industry leaders we spoke with shared some of their insights (outlined below).

Predictive guidance

The current state of virtually all wearables, especially wearables for health, is that they track data and present trends. They help you find out how you’re doing and whether or not you’re meeting your goal—and if you have enabled the social features, how you stack up against your friend.

In the near future, we expect wearables to get even smarter. Instead of tracking and displaying content (i.e., a reactive task), wearables will be able to make predictions and recommendations on how to improve (i.e., a proactive task), based on data collected. These devices will guide the user to do things differently in order to reach a specified goal.

Multiple functionalities in a single device

Today, the majority of wearables serve a single purpose or a number of related functions. They can track the number of steps you take and how many hours of sleep you slept. But if you want to use a wearable to track your heartbeat, control a light switch, measure your breathing, or authenticate your identity, then you need to wear three or four devices. That’s not an attractive proposition. We expect to see new tools emerging that can manage a number of user tasks.

Wearables as a platform

An increasing number of startups are exploring the possibility of allowing developers to access their devices and enhance their functionality. We expect this trend to accelerate, with more startups releasing application programming interfaces (APIs) for this purpose. We have also seen startups create products that are application-agnostic, built with the expectation that the developer community will design the “killer app” for their device.
Many losers, few winners

If the industry conference CES 2014 was any indication, we will see hundreds of products enter the market in the next couple of years. The majority of these will be “me too” devices: products that do not offer new or innovative features. They will compete on price and design. We predict that the majority will fail, and that only the few that offer groundbreaking functionality will survive. The winners will be able to induce behavioural change in users, empowering general consumers to seamlessly move toward being stronger, healthier and happier, and enabling doctors to collaborate on and deliver more personalized healthcare. Successful wearable technology will also leverage the Internet of Things, with devices interacting with their environment.

Prices drop, new business models emerge

Today, the majority of consumer wearables cost between $80 and $300. We expect prices, along with profit margins, to decrease. Entrepreneurs and startups will find ways beyond selling hardware to monetize their innovations. The massive amount of data collected will be a source of revenue, as will predictive and actionable guidance of that data, perhaps delivered via an annual subscription.
References

1 Franklin, Benjamin. *Mémoires de la Vie Privée de Benjamin Franklin*. 1791.


15 Nike, Inc. https://secure-nikeplus.nike.com/plus/products/


References


38 Deloitte. (2014). Wearables: The eyes have it.


43 Deloitte. (2014). Wearables: The eyes have it.


49 Phone interview with Tom Emrich. (2014, Jan 30).


53 Deloitte. (2014). Wearables: The eyes have it.


55 Deloitte. (2014). Wearables: The eyes have it.


65 Phone interview with Tom Emrich. (2014, Jan 30).

66 Phone interview with Tom Emrich. (2014, Jan 30).

References


References


