

RESEARCH REPORT

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EXECUTIVE SUMMARY

Smart Clothing and Body Sensors

Connected Sports and Fitness Apparel, Fashion Apparel, Baby and Pregnancy Monitors, Heart Rate Monitors, Headbands, Posture Monitors, and 3D Trackers

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ADITYA KAUL
Research Director

CLINT WHEELLOCK
Managing Director

SECTION 1

EXECUTIVE SUMMARY

1.1 INTRODUCTION

The age of wearable computing is upon us, with computers that we can wear on our wrists as smart watches or fitness trackers, smart glasses we wear on our faces, and state-of-the-art wearable cameras that we can attach to our bodies to capture and record unique perspectives. The ultimate wearable computer is a piece of smart clothing that one can wear as a garment or a body sensor that can track and measure a specific physical aspect, such as posture or electromyography (EMG) signals from the brain.

The market for smart clothing and body sensors is just beginning to take shape, both from an end-user perspective and a value chain perspective. This report highlights the drivers and barriers from both perspectives, providing an overall snapshot of the current state of the market and how it will grow in the next 5 years, with market sizing and forecasts from 2013 through 2020. The forecasts for smart clothing and body sensors are segmented by region, application market, and connectivity technology. Strategic recommendations are also provided for the players currently participating in this market and for those looking to enter the market.

1.1.1 SMART CLOTHING

Smart clothing has been around for a decade or more, with the miniaturization of electronics leading to integration within garments. However, most smart clothing has been limited to niche usage in high-end fashion, medical, or military sectors. Only now are we seeing the true confluence of electronics and textiles leading to comfortable fabric-based sensors that can be integrated into a garment, or the advent of conductive yarns that can be woven into a smart fabric.

Today, smart clothing is seeing the greatest levels of activity and adoption within the sports and fitness sector, with apparel that can track advanced biometrics, from muscle activity and breathing rates to heart activity zones, providing professional athletes and fitness warriors a deeper understanding of their bodies and fitness levels. Smart clothing provides better accuracy of biometrics, something one is unlikely to get from a wrist-worn fitness tracker or smart watch. Apart from biometrics, smart clothing can also be used to track physicality like movement, pressure, gait, and other features.

Although the market is still in its early days, Tractica expects the momentum to continue building within the sports and fitness segment, with advanced sports enthusiasts adopting the technology for the most part, but the average consumer also following through as the features become simplified and pricing comes down. Industrial applications like fatigue monitoring of workers are also likely to experience growth in the near future.

1.1.2 BODY SENSORS

Body sensors are closely linked to smart clothing, in many cases using similar fabric-based sensors or being attached to a piece of garment. Body sensors include a variety of devices that can be worn or attached to the body for measuring specific information. This includes heart straps worn on the chest for measuring heart rate, headbands for measuring EMG activity of the brain, posture monitors for detecting bad posture, baby and pregnancy monitors for measuring vitals and movement of a baby, and 3D trackers for detecting

movement of the body in a 3D environment.

1.2 MARKET DRIVERS

The market for fitness and health products and services has been growing steadily over the past few years, with increasing awareness around health and fitness, growing sedentary lifestyles, and the related health issues. Mobile apps are targeting health and fitness, as well as innovations in gyms and health clubs. Wearables that target health and fitness are likely to ride this wave, as more of the general consumer base starts to engage in sports activities. Smart clothing will benefit from users looking for something beyond fitness trackers and smart watches, including better accuracy, convenience, specific statistics like muscle oxygen levels, and a deeper understanding of their fitness levels.

The smartphone is the ideal platform for displaying fitness or health data in real time or on an historical basis. The smartphone powered with Bluetooth Low Energy (BLE) has become the de facto hub for connecting wearables, including body sensors and smart clothing. The launch of Apple's HealthKit and ResearchKit platforms suggests that the smartphone's journey as a health hub is just beginning. Smart clothing and body sensors are an extension of that trend and will soon be feeding data into the Apple platforms.

Rather than have the electronics sewn onto a piece of fabric that could cause abrasions due to repetitive skin contact, smart clothing now has sensors built into the fabric itself, without any seams. New technologies like laser cutting, assembly by lamination, or ultrasonic welding ensure that the sensors feel like they are part of the garment itself.

1.3 MARKET BARRIERS

The type of specialized and detailed metrics that smart clothing products provide, including heart rate variability or muscle oxygen saturation, do not appeal to the average consumer. Unless some of this detailed information is put into context and explained in simple language, providing customized insights into the fitness level of a general consumer, smart clothing is likely to remain niche.

Sports and fitness products face some of the highest rates of abandonment among all consumer goods. Smart clothing and body sensors face the same challenge. As the smart clothing and body sensor market enters its initial stages, most companies are focused on getting their product right, having customers feel comfortable wearing the product, or having the companion app work seamlessly on the smartphone. The next stage, which is critical in building stickiness, is building analytics and machine learning capabilities that can adjust and provide customized analysis and push users to their limit, while enhancing their fitness or wellness levels.

Smart clothing brings together two diverse and separate ecosystems: textiles and electronics. There are outstanding issues related to the coordination and interworking between the two ecosystems. Textile manufacturers are unwilling to change their production lines or machinery just for a few smart garments and electronics companies do not really speak the language of the textiles industry. Although, these two industries can come together to build prototypes or limited batch garments, the main challenge is around working together to create standardized processes for high-volume manufacturing.

For smart clothing to grow beyond sports and high-end fashion, one needs an Apple or a GoPro type of device that can make smart clothing cool and desirable, but at the same time affordable and not only for the high end. This would involve popular clothing brands like Gap, Zara, or H&M introducing a smart clothing line with a smartphone or connected element.

Only fashion brands with that level of brand and scale can handle the manufacturing challenges and create awareness within the general consumer base.

1.4 KEY APPLICATION MARKETS

1.4.1 SPORTS

The sports segment is the leading application area for both smart clothing and body sensor devices. Within the sports segment, professional athletes and fitness warriors or serious fitness enthusiasts make up the main user base adopting smart clothing today. A variety of products available in the market includes shirts, sports bras, shorts, and smart socks, all targeting different areas of the body and gathering different biometric data.

Body sensors today mostly include heart rate monitor (HRM) straps used by fitness enthusiasts and professional athletes. 3D trackers are the other type of body sensors the sports segment is using.

1.4.2 CONSUMER

The use of smart clothing by general consumers is extremely limited at the moment, with fashionable smart clothing seeing some interest at the high end of the market. On the other hand, smart clothing like smart shirts is seeing some adoption by general consumers, which mostly includes early adopters, who are not necessarily sports or fitness enthusiasts.

The heart monitoring strap is the leading body sensor device type used by general consumers today. Going forward, Tractica expects the consumer segment to see a growing usage of baby and pregnancy monitors, headbands, and posture monitors.

1.4.3 INDUSTRIAL

Smart clothing in the industrial environment is likely to revolve around fatigue tracking on the manufacturing shop floor or in hazardous environments like oil and gas or mining.

1.4.4 ENTERPRISE

Just like fitness monitors encourage employees to be more active, posture monitors that are part of a corporate wellness program can help employees improve their posture and reduce work-related health issues. Similarly, headbands are also likely to fall within a corporate wellness program, allowing employees to manage stress levels. Both posture monitors and headbands are future applications for body sensors within the enterprise.

1.4.5 HEALTHCARE, MILITARY, AND OTHERS

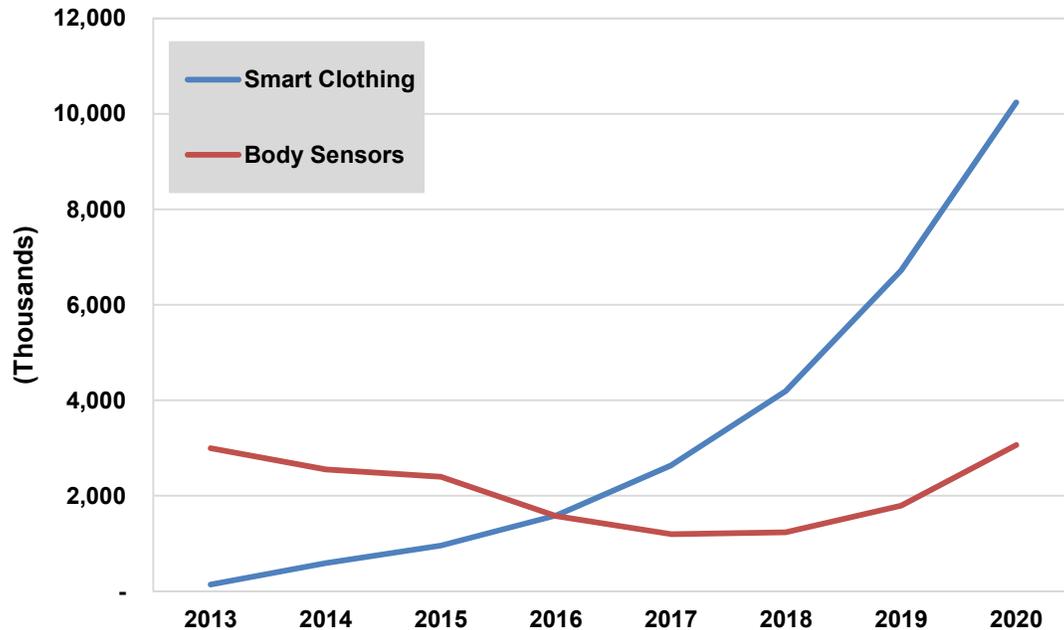
While smart clothing companies are working toward providing solutions for healthcare, we have not seen adoption of smart clothing in the healthcare segment yet, with most of the activity related to research groups. Healthcare is a complex market to penetrate, with certifications and approvals required before any device is adopted, and with lengthy procedures in place for obtaining certification like a Class 1 medical device. Devices that require Class 1 medical device certification are not included in this study.

While Tractica has seen trials of smart clothing for public safety personnel or military, they have not moved beyond the trial stage. This is largely because professional security or public safety uniforms are an established market with a number of companies specializing in such clothing. Also, the costs for overhauling the uniforms in a military or public safety setting are high, especially when there is no clear use case. Tractica expects biometrics or vital sign tracking for such markets to be done through fitness bands or watches.

1.5 MARKET FORECAST

Tractica forecasts that shipments of smart clothing will grow from 140,000 units in 2013 to 10.2 million units in 2020, representing a compound annual growth rate (CAGR) of 84.6%. While smart clothing represents a small portion of overall wearable device shipments, it has one of the highest growth rates, second only to smart glasses. Smart clothing is one of those wearable segments that is starting from a small base, but is gathering momentum, especially as large sporting goods brands start to adopt smart clothing into their apparel lineup.

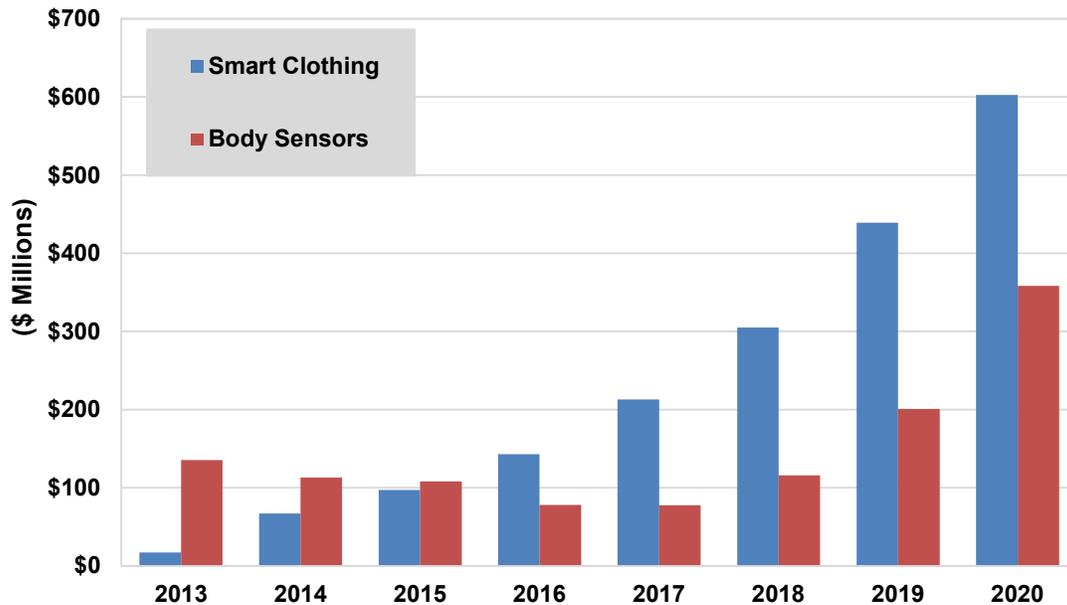
Chart 1.1 Smart Clothing and Body Sensor Unit Shipments, World Markets: 2013-2020



(Source: Tractica)

Tractica forecasts that revenue from smart clothing will grow from \$17.2 million in 2013 to \$603 million by 2020. The majority of this market will be driven by sports applications, but it will still represent less than 1% of the global sports apparel market, which is worth more than \$140 billion today. Tractica believes that, while sporting goods manufacturers will adopt smart clothing into their product lines, they will continue to market it as a premium product, rather than overhaul their complete clothing portfolio.

Chart 1.2 Smart Clothing and Body Sensor Device Revenue, World Markets: 2013-2020



(Source: Tractica)

The body sensor market, which includes heart rate straps, baby and pregnancy monitors, headbands, posture monitors, and 3D trackers, will experience a transition phase, with the market moving away from heart straps toward baby and pregnancy monitors, headbands, posture monitors, and 3D trackers. During this transition phase, overall shipments will decrease from 3 million in 2013 to 1.2 million in 2017, and then increase to 3.1 million by 2020. The revenue from body sensors will increase from \$135 million in 2013 to \$358 million by 2020, representing a CAGR of 15% between 2013 and 2020. The market is transitioning away from a one-device market to a multi-device market, as fitness trackers and smart watches subsume the primary use case for heart rate straps.

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SECTION 10

SCOPE OF STUDY

This report examines the wearable device markets for smart clothing and body sensors. Smart clothing primarily includes sports garments like shirts, shorts, or socks that have sensors woven into the textile or fabric to track body or muscle activity. Body sensors refer to devices that can be clipped on or worn on the body for purposes other than tracking fitness or sleep and include heart rate straps, posture monitors, headbands, and 3D trackers. This report highlights the drivers and barriers for the smart clothing and body sensor market, giving a snapshot of the current state of the market and how it will grow in the next 5 years, with market forecasts from 2013 through 2020. The forecasts for smart clothing and body sensors are segmented by region, application market, and connectivity technology. Strategic recommendations are also provided for the players currently participating in this market, or for those looking to enter the market.

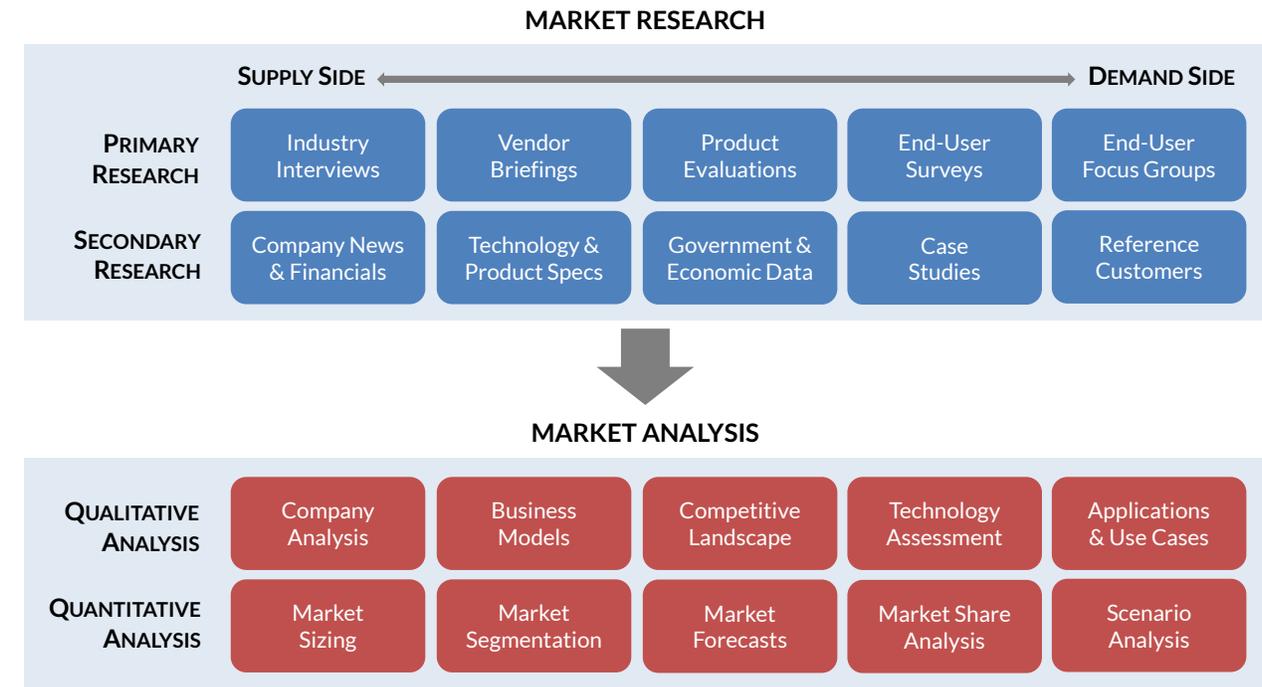
SOURCES AND METHODOLOGY

Tractica is an independent market research firm that provides industry participants and stakeholders with an objective, unbiased view of market dynamics and business opportunities within its coverage areas. The firm's industry analysts are dedicated to presenting clear and actionable analysis to support business planning initiatives and go-to-market strategies, utilizing rigorous market research methodologies and without regard for technology hype or special interests including Tractica's own client relationships. Within its market analysis, Tractica strives to offer conclusions and recommendations that reflect the most likely path of industry development, even when those views may be contrarian.

The basis of Tractica's analysis is primary research collected from a variety of sources including industry interviews, vendor briefings, product demonstrations, and quantitative and qualitative market research focused on consumer and business end-users. Industry analysts conduct interviews with representative groups of executives, technology practitioners, sales and marketing professionals, industry association personnel, government representatives, investors, consultants, and other industry stakeholders. Analysts are diligent in pursuing interviews with representatives from every part of the value chain in an effort to gain a comprehensive view of current market activity and future plans. Within the firm's surveys and focus groups, respondent samples are carefully selected to ensure that they provide the most accurate possible view of demand dynamics within consumer and business markets, utilizing balanced and representative samples where appropriate and careful screening and qualification criteria in cases where the research topic requires a more targeted group of respondents.

Tractica's primary research is supplemented by the review and analysis of all secondary information available on the topic being studied, including company news and financial information, technology specifications, product attributes, government and economic data, industry reports and databases from third-party sources, case studies, and reference customers. As applicable, all secondary research sources are appropriately cited within the firm's publications.

All of Tractica's research reports and other publications are carefully reviewed and scrutinized by the firm's senior management team in an effort to ensure that research methodology is sound, all information provided is accurate, analyst assumptions are carefully documented, and conclusions are well-supported by facts. Tractica is highly responsive to feedback from industry participants and, in the event errors in the firm's research are identified and verified, such errors are corrected promptly.

Chart 10.1 Tractica Research Methodology


(Source: Tractica)

NOTES

CAGR refers to compound annual growth rate, using the formula:

$$\text{CAGR} = (\text{End Year Value} \div \text{Start Year Value})^{(1/\text{steps})} - 1.$$

CAGRs presented in the tables are for the entire timeframe in the title. Where data for fewer years are given, the CAGR is for the range presented. Where relevant, CAGRs for shorter timeframes may be given as well.

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2015 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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1111 Pearl Street, Suite 201
Boulder, CO 80302 USA
Tel: +1.303.248.3000
Email: info@tractica.com
www.tractica.com

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