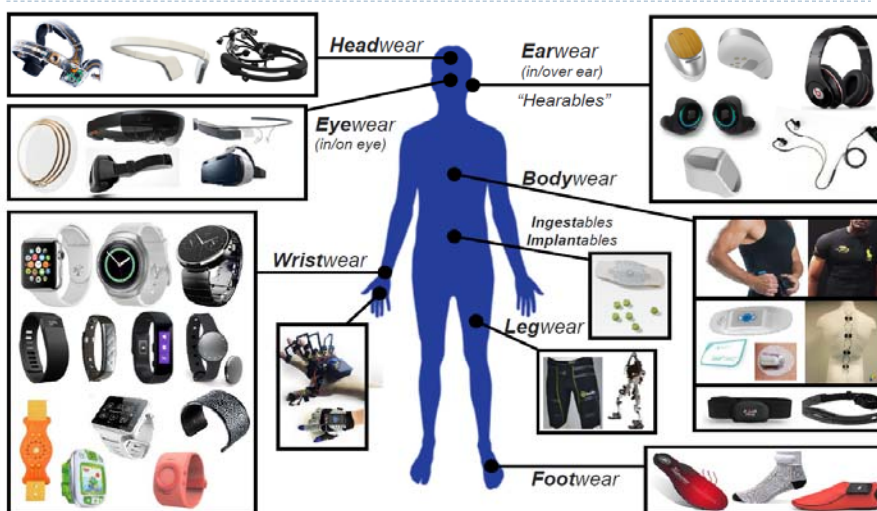


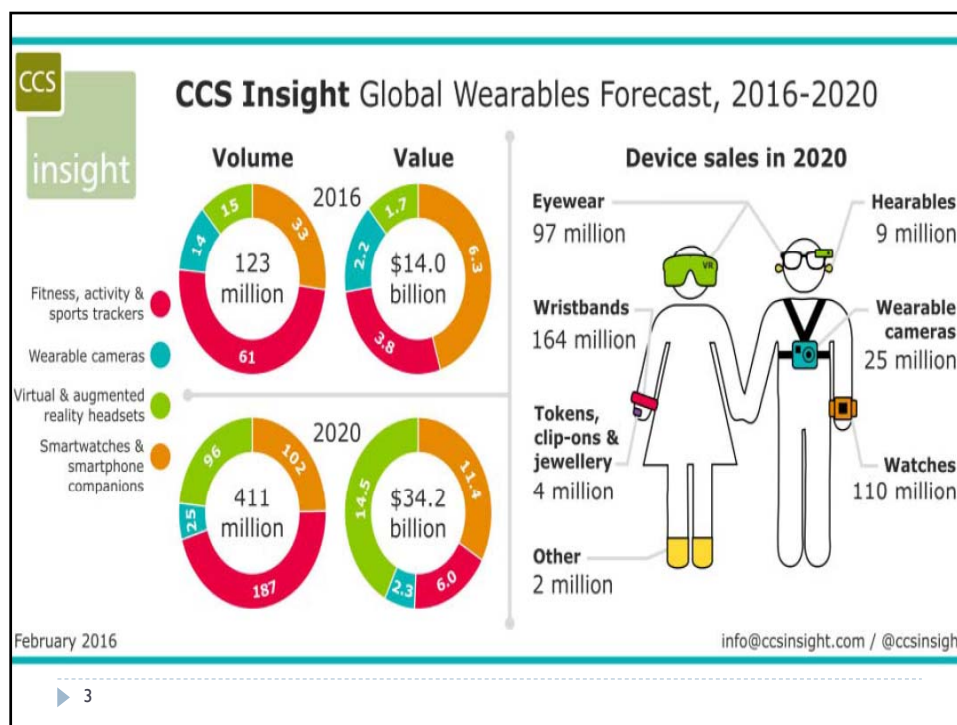
## User comfort and evaluation of smart textiles and wearables

IEC TC 100 AGS Meeting  
Vienna, 25 May 2016  
Ulrike Haltrich

### Wearable smart products



(source: Dr Harry Zervos, [www.IDTechEx.com](http://www.IDTechEx.com), presentation at Workshop Standards for Wearable Technology & Textile Electronics, March 8, 2016, Raleigh, NC)



## PT 100-13 Stage 0 project established

- ▶ **PT 100- 13 User comfort and evaluation of smart textiles and wearables**
  - ▶ To study user comfort aspects of smart textiles and wearables;
  - ▶ To prepare a market analysis including trends;
  - ▶ To identify standardization needs;
  - ▶ To contribute to the work of IEC SG 10 Wearable Smart Devices; and
  - ▶ To prepare a first working draft
- ▶ **Project leader:**
  - ▶ Ms. Ulrike Haltrich (DE)
- ▶ **Experts:**
  - ▶ Mr. Lu Cheng (CN) (replaced by Ms. Zhao Xiaoying)
  - ▶ Mr. Pekka Talmola (FI)
  - ▶ Mr. Tomoo Nishigaki (JP)

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## PT 100-13

- ▶ PT 100- 13 User comfort and evaluation of smart textiles and wearables/Draft Scope of DTR
- ▶ Comfort is the key challenge in creating wearable electronics that people want to wear.
- ▶ Wearable smart devices and smart textiles place specific considerations on user comfort and the evaluation of user comfort aspects.
- ▶ The purpose is to investigate characteristics of wearable smart devices and smart textiles in order to support user comfort considerations.
- ▶ Identify of standards needs and gaps in current and emerging technologies and related standards
- ▶ Consider IoT aspects

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## Evaluation of Wearables for User Comfort

### Comfort/usability/performance (Pekka Talmola)

- ▶ Weight (wristbands, eyewear)
- ▶ Heat generation
- ▶ Breathability (textiles)
- ▶ Waterproof
- ▶ Windproof (textiles)
- ▶ ESD in textiles
- ▶ Battery life time / Recharging interval
- ▶ Method of recharging / battery change
- ▶ Antenna performance
- ▶ EMC from other devices like mobile phones (this could be quite severe in wearable textiles)

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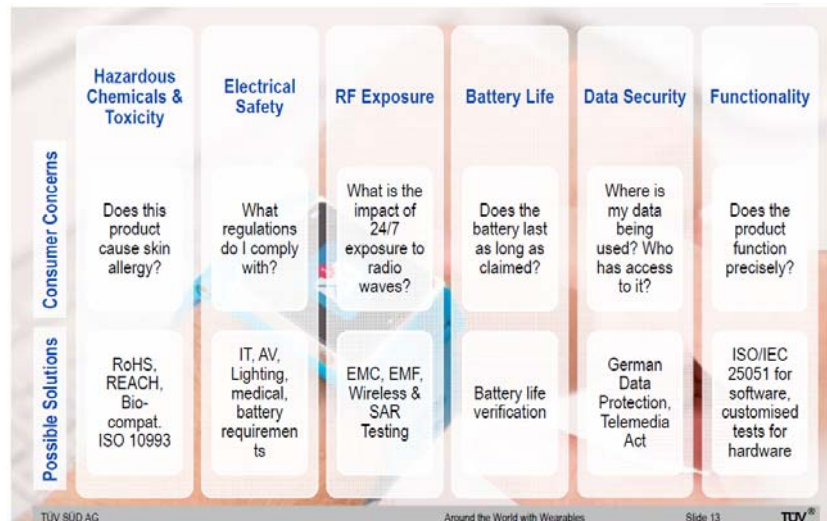
## Evaluation of Wearables for User Comfort

### Safety/risk (Pekka Talmola)

- ▶ Chemicals in materials
- ▶ Allergies
- ▶ Temperature raise (same as above, but maybe safety limit is higher than comfort)
- ▶ Battery contact or other connector contact resistant to sweat, moisture, salt etc.
- ▶ EMF & SAR from radio Tx

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## User Concerns



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## General Comfort Aspects

### Powering schemes

- Energy storage/harvesting devices need increased performance in order to improve consumer experience of novel devices
- Wireless power/data transfer, flexible form factors, transparency, increased power output are some of the requirements

### Flexibility/ Stretchability

- Flexible mobile platforms and increasing integration into all wearables/ e-textiles increase requirements for flexing/stretching
- Displays, batteries, conductive inks, printed sensors, etc. need to continue operating even when under increased strain

(source: Dr Harry Zervos, [www.IDTechEx.com](http://www.IDTechEx.com), presentation at Workshop Standards for Wearable Technology & Textile Electronics, March 8, 2016, Raleigh, NC)

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## General Comfort Aspects

### Miniaturisation

- Limited size and thickness in wearable devices might restrict performance
- Smaller components = more design flexibility, ability to make technology invisible, more room for extensive functionalities, etc.

### Encapsulation

- Use of electronics in moist environments (e.g. washing cycles, during storage in saline, when wet etc.) requires encapsulation
- Batteries, displays, sensors often extremely moisture sensitive

(source: Dr Harry Zervos, [www.IDTechEx.com](http://www.IDTechEx.com), presentation at Workshop Standards for Wearable Technology & Textile Electronics, March 8, 2016, Raleigh, NC)

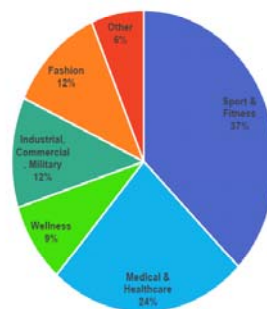
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## Smart textiles

### Who uses smart clothing today?

There are examples of smart clothing throughout several industries:

- Sports & fitness:
  - Compression apparel with electronic functionality is being increasingly used in both elite and amateur sport. This is the focus of much VC and private investment and commercial growth is accelerating.
- Healthcare:
  - Linked to S&F. Healthcare applications are using similar physiological monitoring techniques applied in the rehabilitative and diagnostic sectors.
- Wellness:
  - Heated apparel has been common for many years, and whilst it has not reached huge volumes, this sector continues to maintain steady growth.
- Military:
  - Integration of cabling for data and power communication between equipment offers an excellent value proposition for the soldier. Projects are in development and currently being scaled up.
- Fashion:
  - Technology use in high fashion garments is increasing, but few have produced in large volumes. The interest in this sector is huge but revenue is growing slowly for now.



E-textiles revenue breakdown in 2015 (apparel only)

(source: Dr Harry Zervos, [www.IDTechEx.com](http://www.IDTechEx.com), presentation at Workshop Standards for Wearable Technology & Textile Electronics, March 8, 2016, Raleigh, NC)

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## Specific comfort aspects

- ▶ **Comfort is very important:**
  - ▶ Subjective
  - ▶ Non-restrictive
  - ▶ Breathable
  - ▶ Soft
  - ▶ Flexible vs. stretchable

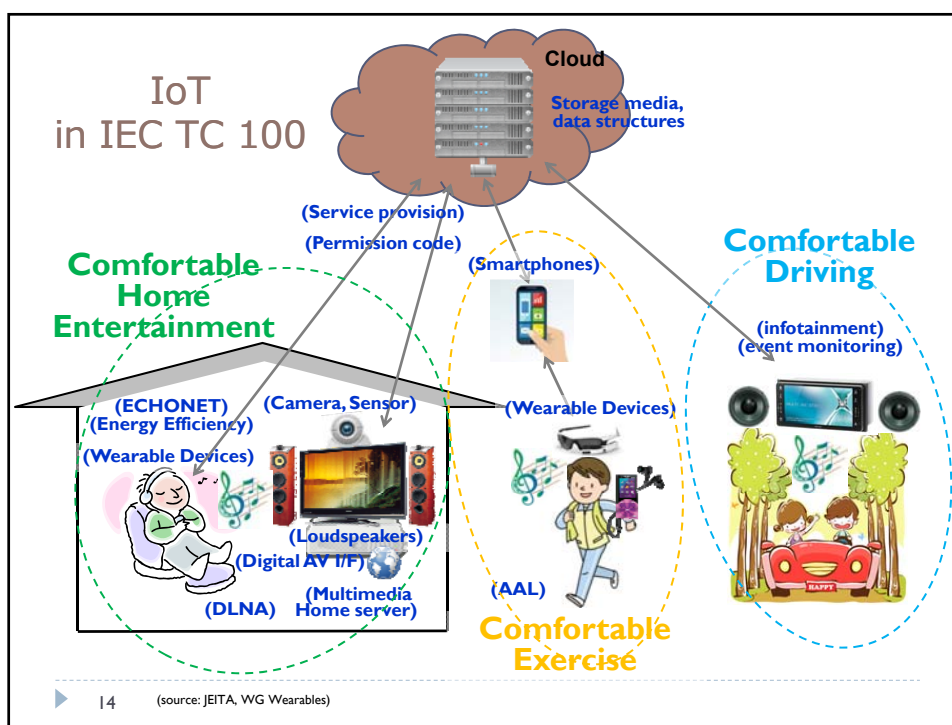
(source: F. Grant Kovach, Under Armour, presentation at Workshop Standards for Wearable Technology & Textile Electronics, March 8, 2016, Raleigh, NC)

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## Specific comfort aspects

- ▶ **Comfort aspects**
  - ▶ Consider the user, the environment of use, the device or system, human factors
  - ▶ Consider intended use/application e.g. health, fitness, entertainment
  - ▶ Expected use; single use, multiple times a week, everyday, how often do they wash the product
  - ▶ Use environment: On field; training; recovery, sleep, everyday life
  - ▶ New services and applications such as eHealth, Connected Cars or Smart Homes, will have a wide range of different requirements regarding performance and Quality of Service

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## Next steps

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- ▶ Need to define scope of DTR and discuss at next meeting in Frankfurt