# European Good Practices in New Materials and New Applications

## ACCLITEXSYS – ACCLImatisation TEXtile SYStem

## New Materials and Applications for Defence

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**CITEVE – Centro Tecnológico das Indústrias Têxtil e do Vestuário de Portugal**

6th RESET Seminar on
"New materials and new applications"
Huddersfield, 31th January 2018

# ACCLITEXSYS

- About CITEVE
- Motivation
- Idea
- Development
- Results
- Difficulties
- Transferability

# About CITEVE...

# CITEVE's Technology Campus

| PORTUGAL

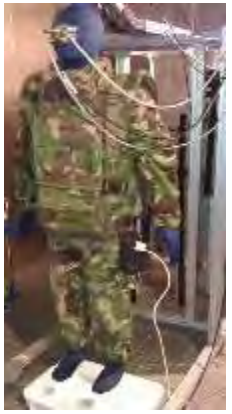
| BRASIL | TUNISIE | ARGENTINA | PAKISTAN | CHILE | INDIA |

# Multi-Market oriented CITEVE

# Main Activity Areas

- Laboratorial Testing
- Product & Process Certification
- Technology & Engineering
- Innovation & Entrepreneurship
- Sustainable Production
- Industry 4.0 & Shop of the Future
- Training & Coaching
- Standardisation
- Design & Fashion Intelligence
- International consultancy






# ACCLITEXSYS

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# ACCLITEXSYS| Motivation

Extremes of **heat**, **cold** and **reduced metabolic heat dissipation** due to **insulating clothing** can seriously degrade soldier's capabilities, putting their life at risk, reducing their performance and compromising mission success.


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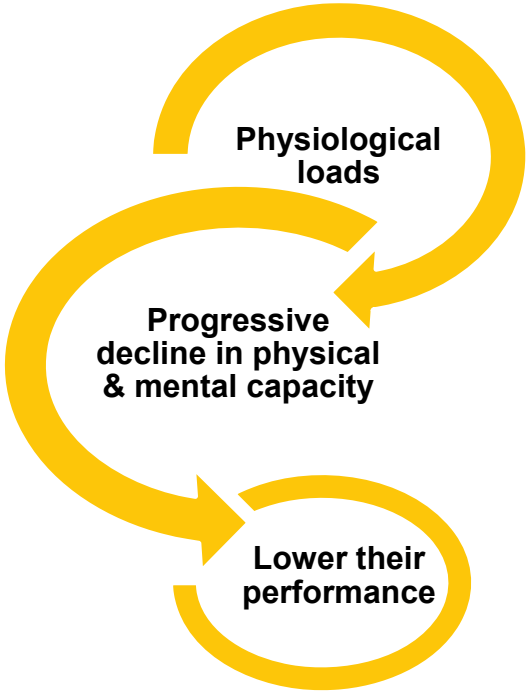


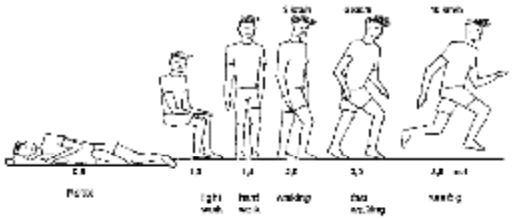

**The clothing impacts on comfort and soldier's performance are of particular importance[1].**

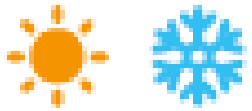
# ACCLITEXSYS| Motivation

**Different technological approaches aiming the stabilization of the soldier's body temperature have been studied** taking into account:

- the task activity levels/metabolic rate
- extreme weather conditions
- equipment carried out and other factors

www.nzdl.org





…in order **to achieve thermal comfort, ergonomics and performance improvement** as military benefits.

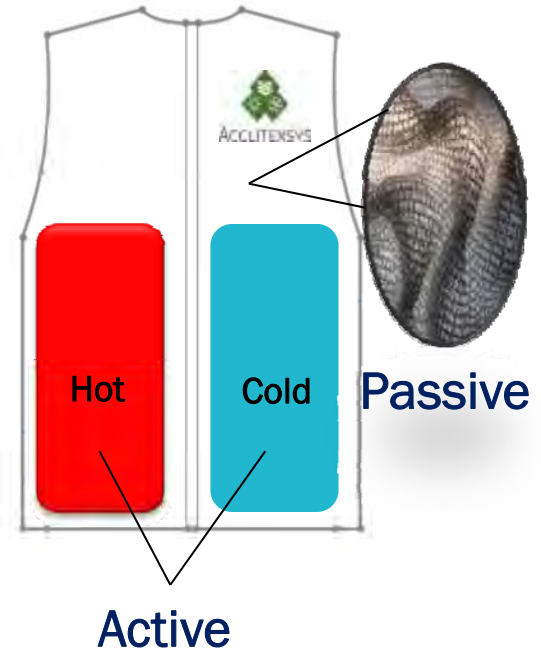
# ACCLITEXSYS| The idea

- To develop a new acclimatisation textile system, regarding active and passive technologies that can act as a temperature regulator to the soldier's body needs.

- To study the potential of spacer fabrics, deploying 3D structured fabric technologies for passive thermal regulation:

  • light weight space fabrics able to improve human body thermal regulation;

  • presenting compressibility, flexibility, air channels, moisture management, thermal resistance, in order to have one textile suitable for hot and cold climates.

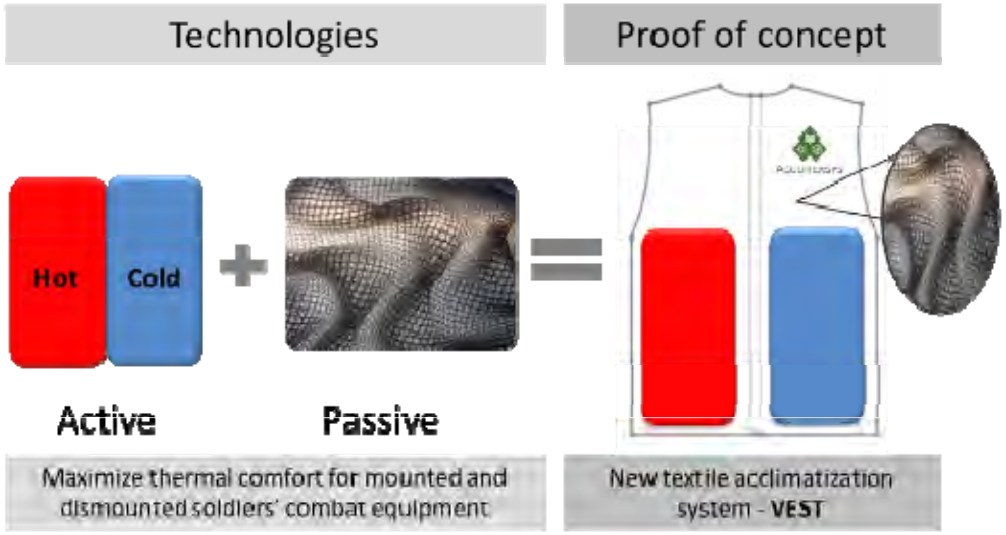



Improved by an active thermoregulation system.

# ACCLITEXSYS| The idea

❖ Spacer fabrics are one of the most versatile fabrics with several possibilities of use in different fields of application:

- sports, protection, military, automobile, aerospace, architecture, construction, agriculture, …



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Climatic Environmental conditions

Architecture approaches

ACCLITEXSYS

R&D + Integration

Proofs of Concept

Tests & Evaluation

# ACCLITEXSYS| Development

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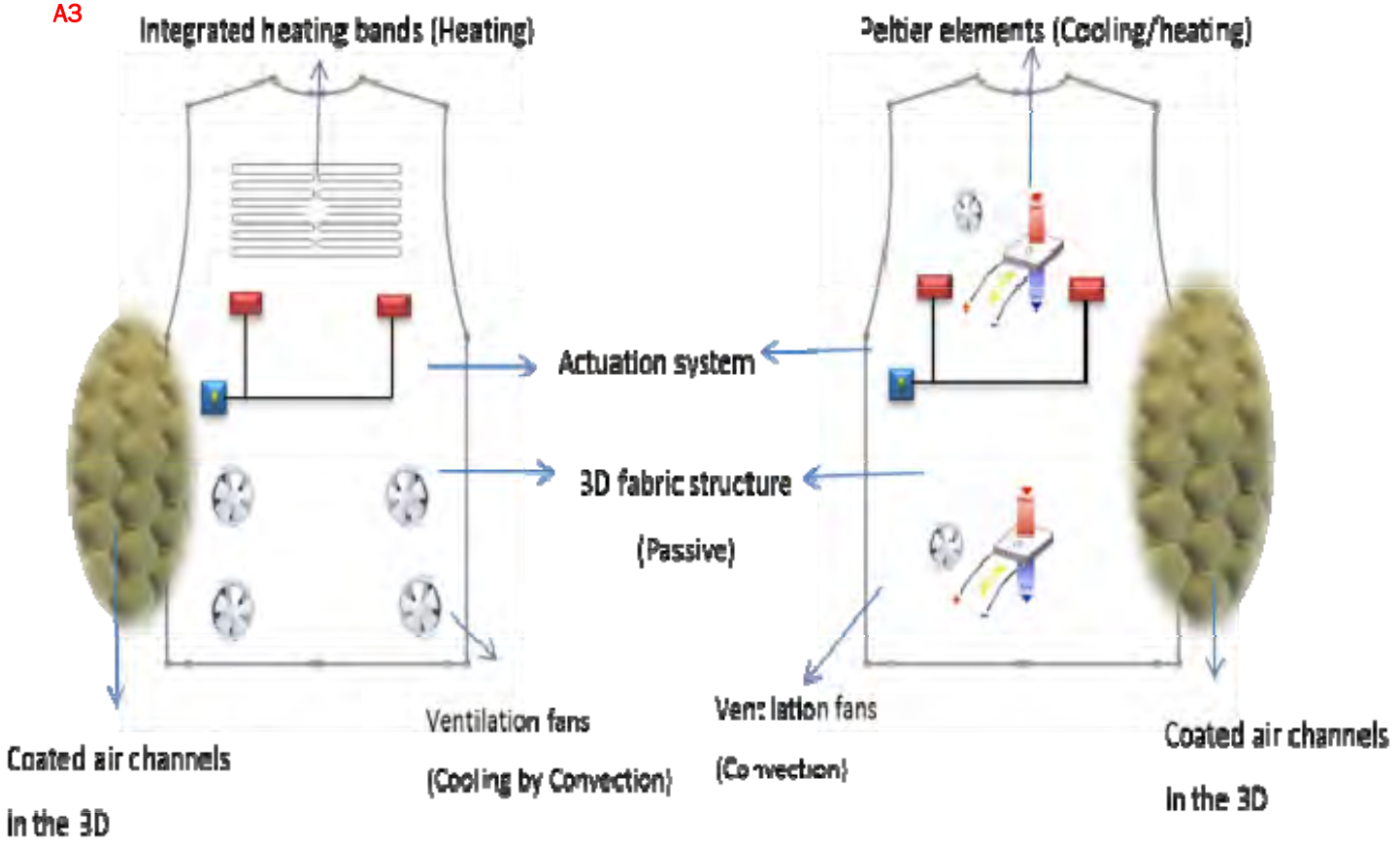
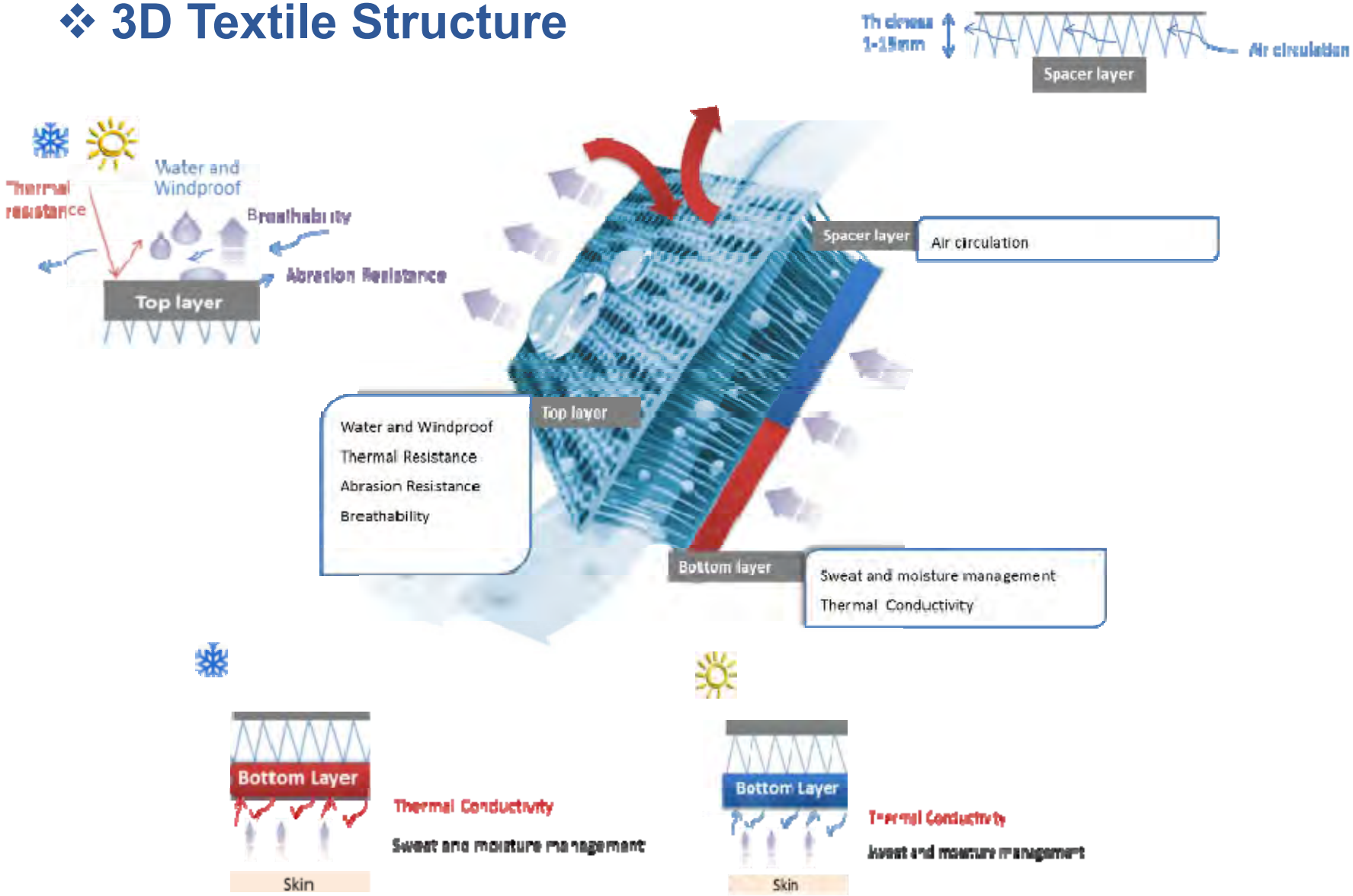
-19°C - 6°C +28°C +39°C

CO A3



# ACCLITEXSYS| Development

## ❖ 3D Textile Structure



# ACCLITEXSYS| Development

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## ❖ Passive system (Multilayer Textile Structure)

**Cork**

- Resistance to compression
- Breathable through the microperforation
- Thermal resistance


**Spacer Fabric**

- Air circulation
- Moisture management
- Resistance to compression
- Breathable
- Thermal resistance
- Comfortable
- Flexible
- Low weight

**Woven Fabric**

- Air Impermeable
- Breathable
- Mechanical properties

# ACCLITEXSYS| Development

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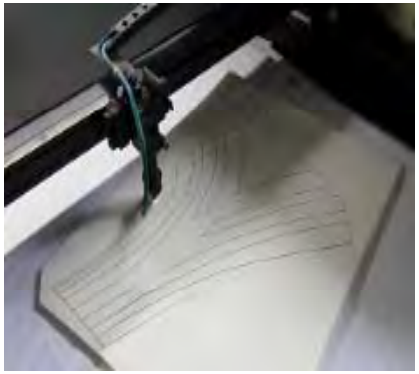
## ❖ Integration technologies

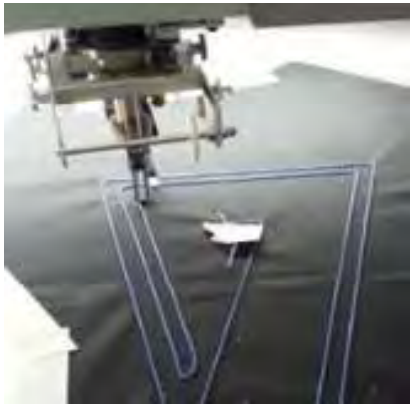
### BONDING

### LASER CUTTING



### SEWING

### EMBROIDERY



# ACCLITEXSYS| Development

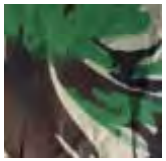
- **Reengineering cycle**
  - To achieve the right balance between moisture management, compressibility, air circulation, thermal resistance and ergonomics.

- ✓ 3D spacer fabric (fiber yarns; top, bottom ad spacer design; thickness; weight; …)
- ✓ Passive thermal regulation complex (laminated multi-layer complex)
- ✓ Passive thermal regulation solution (shape, width and height of air channels)
- ✓ Interactive evaluation of: Skin Model tests according ISO11092/EN 31092; Air flow circulation using a thermography camera

# ACCLITEXSYS| Development

## ❖ Evaluation tests of final products

***Biophysical analysis of textiles***



***Biophysical analysis of clothing in climatic chamber*** *(controlled environment)*

- Thermal Manikin
- Human subjects tests

***Preliminary field trials in non controlled environment***

- In cooperation with the PT Army – School of Arms

# ACCLITEXSYS| Results

✓ **Cooling effectiveness:** proof of concept **A1 without ballistic vest achieved 50Watt until 120 min (Thermal Manikin)**

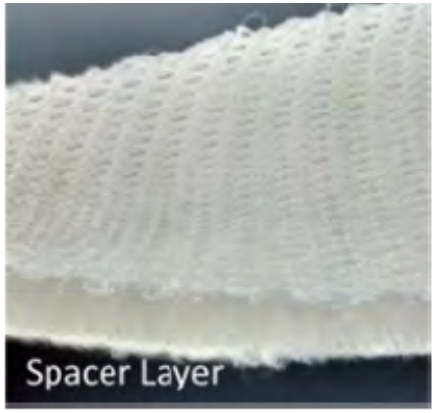
✓ **Heating system:** almost all the **test team members had a perception of more heating (Wearer trials)**

✓ **Impact:** ACCLITEXSYS was considered **functional and positive for cold environment** by end users

# ACCLITEXSYS| Results

VIDEO






# ACCLITEXSYS| Results

- ACCLITEXSYS has been awarded Finalist of INOVA TEXTIL:

iTechstyle Innovation Business Forum, Fev 2015, Porto, Portugal.

# ACCLITEXSYS| Results

- ACCLITEXSYS was selected as **paper** work and presented at **CLOTECH2015, Poland:** *"New methods for comfort and ergonomics evaluation of smart acclimatization textile system".*

- ACCLITEXSYS was selected as **paper** work and presented at **ECPC2016, Turkey.** *"Specification of human subjects and field trials protocols for smart acclimatization textile systems"*

- In addition, the project allowed **to promote and stimulate innovation and technological development of consortium partners**, increasing their competitiveness by creating synergies between two companies from different sectors and countries (DAMEL - a Portuguese clothing manufacturer and SAGEM - a major French company of electronics and communication systems), and two research technological entities (CITEVE from Portugal and AITEX from Spain):
  - **New EDA project – ConCEDS / New project proposals**

# ACCLITEXSYS| Difficulties

- The development of a **3D fabric with less weight and maintaining a good compressibility resistance** (suitable to maintain the thickness needed even when using a bulletproof vest) **and moisture management:**
  - R&D of 3D spacer fabrics using different yarns and structures (top, bottom and spacer layer) and different thickness.
  - Development of several samples followed by laboratory tests and addition of special micro perforated cork layer.

- To find the **suitable design and technology for doing the air channels into the 3D fabric** (to improve the air circulation):
  - Spacer layer design combined with a special cutting process.
  - Development of several shapes followed by end-user tests.

# ACCLITEXSYS| Transferability

- **2 innovative proofs of concept**, both **using 3D spacer fabrics** as a very innovative textile solution for passive thermal regulation.

- Despite the proofs of concept were **developed for military**, they **can easily be transferred to other type of users** as workers or people in cold and/or hot environments.

- **3D spacer fabrics developed have a high potential for exploitation in various applications**: personal protective clothing or equipment's, bulletproof vests, impact protectors, thermal regulation materials for home and vehicles, among others.

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European Regional
Development Fund

# Thank you!

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*Project smedia*