Working Package WP 4
Hub “Additive manufacturing”

Deliverable 4.2
Mapping “Additive Manufacturing Ecosystem and Network" Report

Grant agreement no.:	825647
Call identifier:	H2020-ICT-2018-2 – ICT-32-2018 – STARTS
Objective:	The Arts stimulating innovation
Start date of the project:	01.12.2018
Duration	36 month

Re-FREAM is funded by the European Union's Horizon 2020research and innovation programme under grant agreement No 825647.

Re-FREAM
Re-Thinking of Fashion in Research and Artist collaborating development for Urban Manufacturing

Re-FREAM

Re-Thinking of Fashion in Research and Artist collaborating development for Urban Manufacturing

Working Package WP 4

HUB “Additive Manufacturing”

Due date of deliverable: 30.08.2020

Actual submission date: 15.12.2020

Lead Beneficiary for this deliverable: PROFACTOR

Contributions by: HARATECH, STRATASYS, EMPA, Kunst Universität Linz, CREATIVE REGION

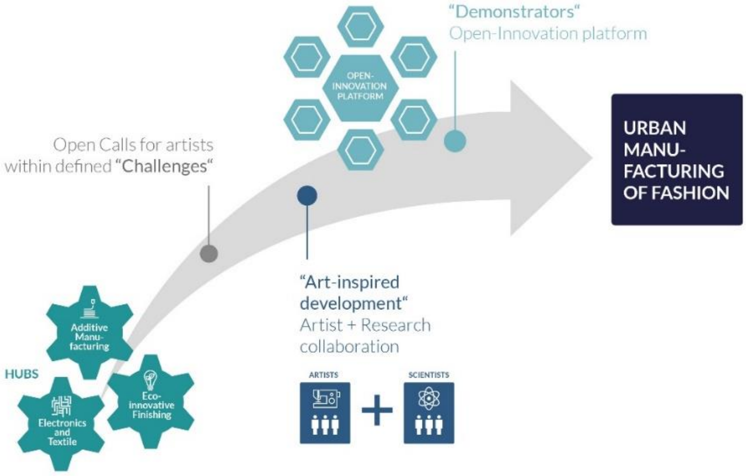
Project co-funded by the European Commission within H2020 Framework Programme		
Dissemination Level		
PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	
Type		
R	Document, report (excluding the periodic and final reports)	X
DEM	Demonstrator, pilot, prototype, plan designs	
DEC	Websites, patents filing, press & media actions, videos, etc.	

Contents

0 Context Information

0.1 The Re-FREAM Project

Re-FREAM will support **art-driven innovation** in European R&I projects by inclusion of artists in research consortia via linked third-parties. The artistic community receives a strong support from art-related partners like the Art University of Linz (UFG) and the European Institute of Design (IED), creative hubs and facilitators like Wear-IT Berlin (FashionTech), AITEX, ARCA and Creative Region combined with remarkable technology from IZM Fraunhofer (E-textiles), STRATASYS, HARATECH (3D-printing), EMPA (3D body simulation), Care applications (Garement nebulization) and PROFACTOR (Additive manufacturing).



Re-FREAM boosts **art-inspired urban manufacturing**, where the city becomes a new production space. Especially for **creative fashion**, urban manufacturing offers a great opportunity to create an alternative to the much criticized production in low-wage countries.

Three technologies (additive manufacturing, electronics on textiles and eco-innovative finishing of fashion) will be explored together. **In co-creation** 20 awarded Artist/ Researcher teams, digitalized manufacturing of fashion will be developed up to TRL 5 to enable small-scale production of fashion in urban environment. An **Open-Innovation Platform** will finally link the know-how and the communities of the hubs, will offer access to relevant facilities and make the Re-FREAM art-inspired urban manufacturing working model sustainable.

0.2 Document history

Version	Date	Change/Reason for change
V1.0	31.07.2020	Initial draft prepared
V1.1	02.11.2020	First Input from CRE, EMPA and HAR included
V1.2	10.11.2020	Updated draft prepared, after review meeting and incorporated reporting suggestions.
V1.4	14.12.2020	Updated version with compiled input from involved partners

0.3 Purpose and Scope of Deliverable Report D4.2

This deliverable will describe the concept of a sustainable ecosystem of additive manufacturing technologies and networks for urban fashion manufacturing including desktop research on additive manufacturing facilities, research on state of the art technologies, mapping of other additive manufacturing networks and providing a state of the art profiles on relevant technologies and network on WP7 platform.

1 Introduction

Within Re-FREAM Hub Linz focuses on the challenge "from 2D to 3D". In this sense, Re-FREAM technology development is centered around bringing 3D printing and additive manufacturing to fashion industry. A fashion manufacturing framework represents one of the objectives of Hub Linz, besides prototype development via selected co-creation projects and establishing a sustainable fashion manufacturing ecosystem in the field of "directly printed fashion".

Within the first half of the project, together with the co-creation projects, Re-FREAM did its first step away from state of the art technology solutions in went beyond. Prototypes where presented at Ars electronica festival in 2020 as well as presented online on youtube and social media. Besides this, collaborations where formed with other players in the field of urban manufacturing of fashion.

This report provides an overview on the current state-of-the art in 2020 with respect to urban additive manufacturing at Re-FREAM partners, as well as provides an overview on outside of Re-FREAM. The focus lies on the known collaborations already established, but also provides a summary of players in this field.

In should also be mentioned that this report, besides D5.3 acts as base for the technology mapping within the open innovation platform of Re-FREAM in WP7 as it is depicted in Figure 1.

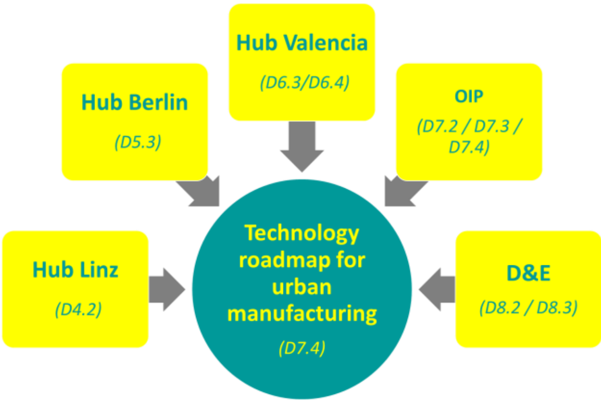


Figure 1: Re-FREAM Technology roadmap for urban manufacturing and ist contribution from other aspects of Re-FREAM

As can be seen, the technology roadmap for urban manufacturing within Re-FREAM is fed with several individual parts out of the individual hubs within Re-FREAM (Linz, Berlin, Valencia) as well as activities within the open innovation platform and general dissemination and exploitation activities. This report (deriving from Hub Linz represents one puzzle piece). The respective deliverable D7.4will be reported in month 36.

2 Status on additive manufacturing facilities for urban manufacturing within Hub Linz

2.1 Within Hub Linz

2.1.1 STRATASYS:

During the period of the last 12 months Stratasys has been diligently crafting a partnership with Dyloan. https://www.dyloan.com/. Establishing a manufacturing partnership for the high end fashion market. Dyloan is an Italian company specialized in production of innovative solution for the high end fashion market , among their clients, Kerning group, Givenchy, Dolce Gabbana, Chanel etc. Together with Dyloan we have been processing the testing to match the market standards for the 3d printing on textiles, these tests include laundry, drying, rubbing, fatigue, friction , UV , aging etc. the results have been positive showing that we can match with 30% out of a range of 100 different textiles the demands of the high end fashion brands, for accessories, shoes, bags and clothing. End 2020 a new institute has been opened, a format of a maker hub, in Milano. This institute D-house will be the new innovation hub for the high-end fashion market. Stratasys has installed it's Beta fashion printer in D-house in November 2020. https://d-house.org/. these will operate as fashion laboratories and research for urban manufacturing, in December 2020 we will set 3 Polyjet fashion printers at the facilities of Dyloan in Chieti Italy.

2.1.2 HARATECH:

In the field of urban manufacturing, we work mainly with FFF printers. We are used to test and try out many new materials (hard, soft, bio-based, filled with fibres and other additives such as laser activated pigments…). We also have a Polyjet (inkjet) and a 3DS Printer (Color Jet Printer).

In a short-term perspective, we aim to purchase a pellet extruder and to adapt an FFF printer to be able to print an even wider range of materials. Moreover, we will acquire a multi-filament extruder to widen even more our creation capabilities.

2.1.3 Kunst Universität Linz (UFG):

We have one FFF printer at our department, an XBOT 320 CE, which we mainly use for small test prints. Some of our students are experiment with printing on fabrics by pausing the print after the brim is done and then printing over it.

2.1.4 PROFACTOR:

PROFACTOR is a research company focusing on new methods for integrated production technologies, especially additive micro/nano manufacturing. Additive manufacturing processes are the key to competitive production in small batch sizes and individualized products. PROFACTOR is enabling innovative products and processes by functionalizing and individualization of freeform surfaces using Nanoimprint Lithography (NIL), Inkjet Printing or Inkjet-based or filament-based 3D-Printing. Within Re-FREAM PROFACTOR focused on translating inkjet-based solutions one step further to market relevance, e.g. functional printing on textiles and fashion articles in collaboration with STRATASYS.

Especially via YOKAI project within Re-FREAM, PROFACTOR contributed with its excellence in robotics and robot programming. This aligned very well with PROFACTORs R&D portfolio and activities in bringing additive manufacturing on complex shapes (e.g. inkjet robot, etc.) to industry and to target new applications.

2.1.5 EMPA:

The Laboratory for Biomimetic Membranes and Textiles at EMPA is a group of about 50 researchers and students working in the fields of medical textiles, adaptive membranes, body simulation systems to investigate body-environment interactions and new body monitoring approaches. We develop new materials and systems for better protection and increased performance of the human body, such as on adaptive and smart materials for improved human thermoregulation, personal cooling systems, as well as new sensors for body monitoring. On the modelling side, we strive for a better understanding of the complex interactions between the human body, clothing systems and the environment through continuous development and improvement of a variety of physical and physiological models (Figure 1a). Our core expertise includes the simulation of complex interactions between the human body, clothing and the environment, including 1) mathematical models of human thermoregulation for various conditions, 2) realistic models for heat and mass transfer in clothing systems that take fabric properties, clothing fit with corresponding air gap distributions, and realistic body posture into consideration, 3) validated global and local thermal sensation and thermal comfort models for indoor and outdoor applications. In practice these tools can be used in a very early design stage without having any prototypes ready to optimize the design for a given purpose in an iterative cycle. The tools offer high accuracy and very short simulation time. In addition, we have measurement equipment, such as a range of thermal sweating manikins (whole body, head, foot, hand, torso) for characterizing ready wear products/prototypes and several instruments for characterizing fabrics/materials anticipated for wearing close to skin (moisture management tester, hot plate, contact angle, thermography, uCT for wicking and moisture management tracing) (Figure 1 b-e). These tools can be used to confirm the designed performance of the prototype in the realistic wear conditions as well as could serve as a basis for comparison with competing products. Newly developed materials can be also quickly tested based on small samples for best required performance. The aim of this research are the development of new materials and systems to support thermoregulatory functions and the improvement of safety and human performance for applications in leisure and occupational settings, sports and medicine.

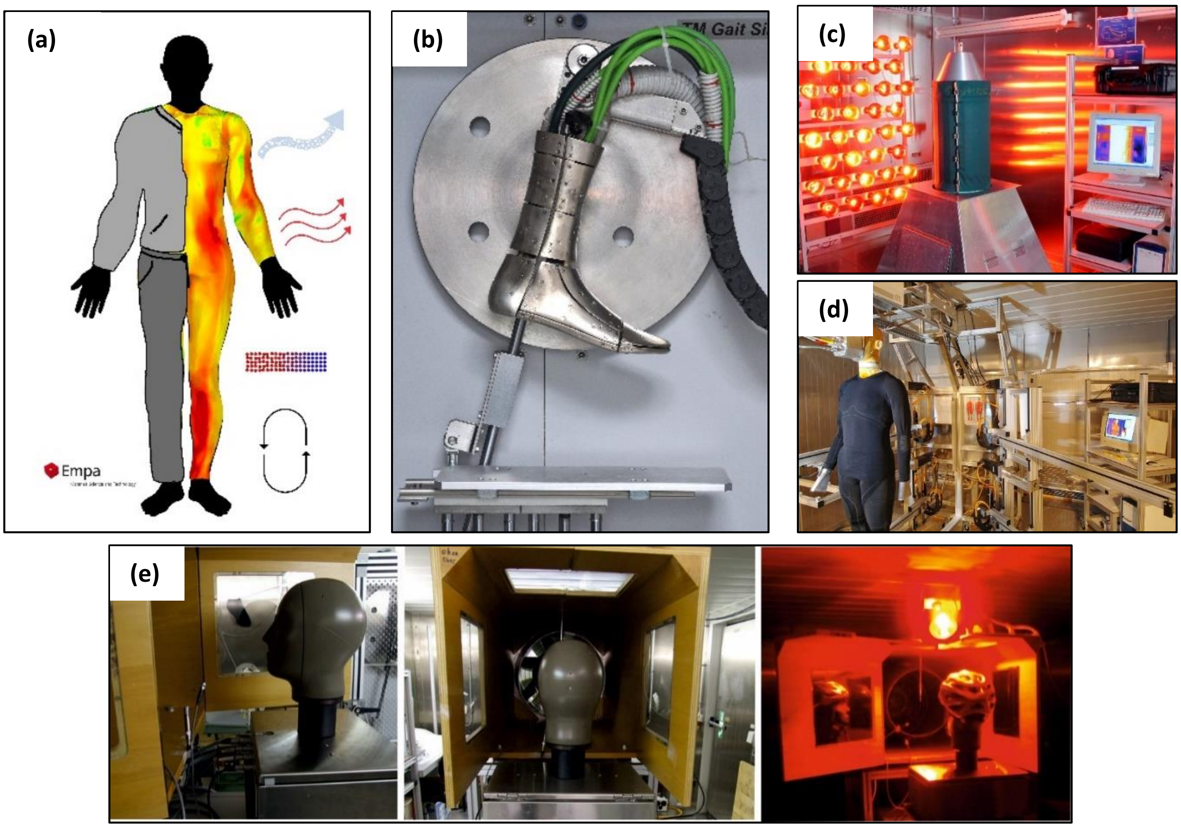


Figure 2: Examples of tools and measurement devices available at Empa, such as (a) models simulating interactions between the human body, clothing systems and the environment, (b) sweating walking foot manikin, (c) sweating Torso manikin, (d) full body manikin, (e) sweating head manikin.

2.1.6 Organizations and companies outside of Re-FREAM

Who	Description (incl. Webpage)
Grand Garage Linz https://grandgarage.eu	The Grand Garage (GG) is a makerspace located in the centre of Linz, in the innovation campus of the tobacco fabric (Tabak Fabrik Linz). It is a place where idea generators, makers and creatives find labs and high-end technology facilities to convert their ideas to reality. On 4000m2 makers find technologies and machines in the field of 3D printing, Lasercutting, CAD, wood lab, post production, sheet metal processing, robotics, CAD, Blechbeartbeitung, Robotik, CAD, painting technology, welding technology, CNC lab, CR, electronics and lightweight construction area. Learning exchange within the community is enhanced by giving workshops that enable also beginners to build up know how and start constructing and prototyping on their ideas by using the technologies available. Recently, the GG also plans to open a textile lab. Also, the robotic department of the UFG Linz (Re-FREAM Partner) is located there and the Yokai Studios (artist of the first round or Re-FREAM) have their workspace in the Grand Garage.
Kobleder GmbH https://kobleder.at/de/	Kobeleder is a company with a long tradition in producing knit fashion, located in the rural area of upper Austria. Over time, the company put knitting technology in the focus and developed from flat-knitted textiles to 3D knitted structures and is now a leading company in 3D knitting and innovative Tech-Knits. They are not only using knitting robots to produce seamless knitwear made with natural fibres, but also focused on innovation by 3D knitted shapes with synthetic fabrics that enables to produce furniture (e.g. 3D knitted seating furniture), protection wear (spacer fabrics) that are absorbing dangerous acceleration forces and prevent fall injuries, knitted lamps and luminaires, as

	well as during Corona Pandemic they shifted to urban manufacturing of knitted face masks. One example of their development of technology is e.g. the Kobeleder Non Crimp Knit, that was developed together with the TU Dresden.
Media Interaction Lab (MIL) http://mi-lab.org	The MIL is located in Upper Austria, at the Campus of the University of Applied Science in Hagenberg. The research lab is focusing on textile interfaces research and TextileUX. TextileUX proposes the creation of multifunctional and textile-based sensing systems and aim at seamless embedding of computational environments. It operate on the interface of material, textile and computer science. The research areas incorporates the design aspects of textile interfaces, textile-embedded sensors that react to pressure, technical yarns and applied prototypes.
Wearic https://www.wearic.com/hackathon/	Located in Vorarlberg, Austria, closely embedded to the Vorarlberg Textile Hub, Wearics is focusing on Smart Textiles and the daily usage of them. They aim on transferring basic knowledge about the work with technical textiles to everyone and make knowledge accessible. They invented a do-it-yourself- Kit with textiles Sensors, that is also using Plug and Play Technology (Arduino Nano). The Kits can be bought on their website for different daily-life applications. Knowledge on application and building with those components can be found on their websites "learning" section. Also, they are organising Hackathons in the Area of Smart Textile Applications.
Neuzeug https://www.neuzeug.at	Neuzeug is a union of 2 Austrian based Designer that created the label together and located it at Steyr, in the broader Area of Linz, Austria. The focus of their work is regional, hand manufactured, high quality lamps made out of porcelain. Neuzeug managed to further develop a 3D printer to enable it to print porcelain. This technology allows them to create individualised luminaires with fine, translucent porcelain.
LIMuZZ https://limuzz.com	Limuzz is using 3D printing technologies to manufacture individualised dog muzzles with out of a 3D printer (SLS Technology). There are 4 basic design types to select from as base. Those base-types initially got established by 3D scanning different dog breed and their individual snout measurements. The customer can order a perfect fitted muzzle by measuring their pet and sending some measurements (length, height and scope of the pet's snout) to Limuzz, where an a digital design process the base type of product gets adapted. With this adapted design they enable individualized, anatomical fitted, local produced items that are lightweight (made from rubberlike plastic, TPU), and easy to handle.
Dyloan https://www.dyloan.com/	Milano based, Dyloan is a specialized company in production innovation for fashion market, it is a new set partner for Stratasys that will be responsible to embed the manufacturing of 3d printing on textiles for urban manufacturing. In the facilities 3 SSYS(STA) Polyjet printers specialized for 3d printing for fashion.
D-House https://d-house.org/	D-house, Milano, established end 2020 will be the innovation hub for the high-end fashion market. Stratasys has installed its Beta fashion printer in D-house in November 2020. these will operate as fashion laboratories and research for urban manufacturing.
V-Trion https://www.grabher-group.at/de/seiten/v-trion-textile-research-gmbh_4	Textile research company with focus on Basic research, biopolymer research, etc. in the area of smart textiles and smart electronic sensing integration on fabrics and textiles.
Vienna Textile lab	Vienna Textile Lab fabricates organic colours made by naturally occurring bacteria in order to provide the most sustainable, wholesome and environmentally friendly alternative to conventional synthetic colours.
Sansirro https://sansirro.com/	Fabrication of sports wear
Trans textile https://www.trans-textil.de/	Distributor of functional wearables and coating of textiles
Infabity	Company based on producing customer products, with the accent put on individual customisation.
Yokai	Producing garments using 3D-printing

3 State of the art technologies

3.1 Within Re-FREAM

3.1.1 3D Printing technology

Traditionally, the predominant use of textiles as fashion materials has led to the development of 2D pattern-making methods for dressing the complex shape of the three-dimensional human body. Nowadays, digital design tools allow us to easily design and 3D print complex shapes for the human body.

Within Re-FREAM the focus lies on Polyjet by STRATASYS as the main 3D printing solutions. This technology is similar to the well-known ink-jet printing processes but uses curable liquid acrylic-based photopolymer resins onto a build tray to build up 3D structures. With this technique it is possible to build up objects by additive manufacturing, also commonly known as 3D printing.

3.1.1.1 Polyjet

Within the last 2 years STRATASYS released new types of printers (J850 and J55) besides new materials etc. A small overview is provided below. However, STRATASYS is constantly researching for new (functional) materials and printing solutions in a variety of applications.

Printer:

- J55 - Full color polar 3Dprinting system suitable for small offices, design studios , design workshops and small office areas.

Software:

- Objet 30 - Small single material office friendly 3D printing system for educational , design and engineering purposes.
- Objet260 8/3 - High End Multi-Material /Full Color 3D printing system for design studios , 3D workshops , 3D Service providers and engineering companies.

Material:

- VeroUltra clear: improves upon the past performance of VeroClear with higher level of clarity, transparency and a lower yellow index, potentially applied for packaging prototypes, eyewear and lighting component prototpyes and medical applications.

3.1.1.2 Fused filament fabrication (FFF)

Since its continuous development in the last decade, FFF (a.k.a. fused deposition modelling, FDM) now has a wide range of accessible technologies – always broader and easier to get.

The bed size of the biggest printers range up to a few cubic meters, though it is also to mention that thanks to some “tricks” (VLP technology, printing on a conveyor belt, mounting the printhead on a robot arm), the building volume can be extended to sizes of several meters. With closed printers, the room and print bed temperature can reach up to 200°C, where the nozzle can reach 420°C for the most demanding materials.

Regarding the materials, virtually all thermoplastics are printable, the most common being ABS, PLA, PC, but also PEEK, PEI, PEKK, or TPU. Many come in various colours, transparency and hardness values. Soluble support material are also available, as well as on-spot added fibre thread, for a local and specifically oriented mechanical strengthening. Filled filaments are of course printable, with glass, carbon, or organic fibres (wood, hemp), but also metal, ceramic, or stone powders.

A wide range of accessories also allow a great design freedom and creativity: pellet extruder to print and blend even more materials, multifilament extruder, laser cutter, viscous material extruder, milling tools, glass fibre unwinder and cutter, fabric holder, etc.

3.1.2 Design software

In the following an overview on state of the art design software is provided relevant for from 2D to 3D challenge within Re-FRAM Hub Linz.

App	Brief Description
Rhino/Grasshopper	general 3D modeling, NURBS Surfacing, flattening for pattern export, parametric design, export ready for 3D print
Clo3D, Assyst	Virtual prototyping, pattern generation and export, importing of custom made avatars or (adapted) body scans, textile simulation and virtual fitting.
Meshmixer, Instant meshes	General mesh tools for sculpting and analysis, retopologizing, quad mesh output, support structure generation, general mesh repair
Makehuman	Custom avatar generation with parameters for size as well as age and gender for all limbs
Keyshot	Real-time rendering, tool for quick visuals or production renders/animation, node-based material creation with displacement mapping, 3mf export for polyjet printing.
Adobe Creative Suite	Design tools for presentations, moodboards, pattern and material maps.

3.1.3 Modelling and simulation

Background

Every garment, equipment or accessory worn on the body affects its thermal balance, and hence, thermal perception and comfort. This issue is well known and researched in the occupational field where human health and productivity is on stack but it is less appreciated in the casual and high fashion. The models available nowadays in the scientific literature are capable to address effects of typical clothing on the entire body and body regions including variety of clothing fits. This is possible thanks to availability of accurate 3D body scanning technology that allows determination of air layers within clothing system with great precision. Enclosed air between clothing layers and the adjacent air layer on the top of clothing provide the bulk of thermal and often evaporative resistance, and hence, affect directly heat exchange between human body and the environment. To determine the air layers in the clothing system before any prototype has been made a commercial catwalk simulation software, for example, CLO3D, Vidya, Modaris, can be used. Such software allows virtual sewing and draping of clothing on human body and detailed determination of air layers in single- and multi-layer clothing.

To fully address the human thermal interaction with clothing a sequence of models addressing distribution of air layers in the clothing, physical phenomena of heat and moisture transfer in multi-layer clothing system, human thermoregulation and thermal perception is needed (Figure 3). A unique opportunity to use all necessary models coupled in a comprehensive simulation is offered by Empa. The model sequence includes human thermoregulation model by Fiala, a series of thermal sensation models available in standards and scientific literature, comprehensive clothing model connected to CLO3D software to obtain realistic air layer distribution in a simulated ensemble.

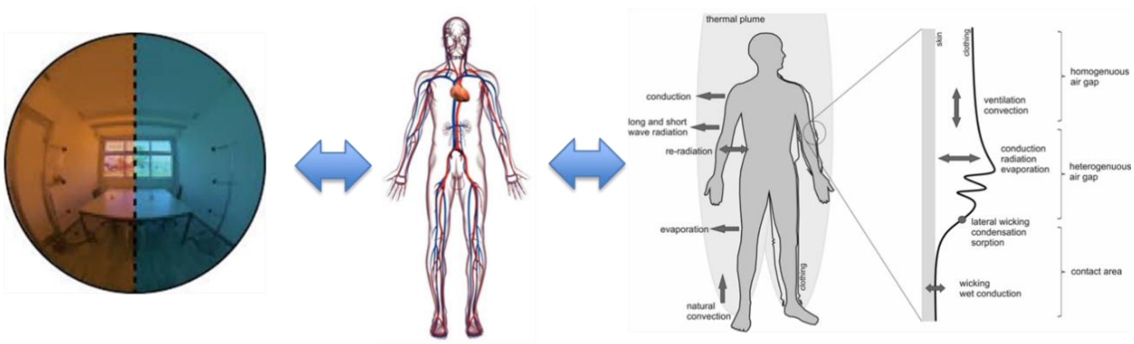


Figure 3: Combination of models necessary to simulate human thermal interaction with clothing including human thermoregulation and thermal perception models, clothing model with air layers and physical mechanisms of heat and mass transfer as well as environmental proximity model.

Models description

CLO3D (CLO VIRTUAL FASHION Ltd, South Korea) is commercial software to virtually design, sew, and drape clothing on an avatar of the human body. As one of very few software it offers opportunity to animate the avatar and clothing to observe clothing in dynamic setting colliding with the body and constantly changing the drape according to the body movement. Based on comparison of the simulated garments and identical garments 3D scanned on a manikin, the CLO3D accuracy is well below standard deviation of the experimental data (several scan attempts of the same garment after redressing on the manikin). The simulated garments and the human body can be then exported into a 3D format and processed in Geomagic Control (3D Systems Inc, USA) to obtain local distribution of air gap thickness and contact area between the body and the garment.

Clothing model is a model developed at EMPA that is able to quantify individual heat transfer mechanisms inside air layers and fabrics. These can be determined for desired body resolution, which typically corresponds to the body resolution of human thermoregulation models. This unique model accounts for local heterogeneity of the air gap, which has significant impact on model accuracy (accuracy improved by 20-30% as compared to models assuming homogenous air gaps). The thorough validation of the model using cases with increasing level of complexity showed model accuracy below 10% of the simulated heat loss, which made it a leading model in the field of clothing thermal simulation.

Human thermoregulation model is a model of human thermal physiology developed by Dusan Fiala. It consists of the passive system representing human body divided into tissues and blood vessels and the active system simulating human thermoregulatory actions, such as alteration of skin blood flow, sweating and shivering. This model has been thoroughly validated at EMPA based on over 100 validation cases reported in the scientific literature and was proven to be accurate (root-mean-square deviations lower than standard deviation of experimental data) and reliable for variety of mild and extreme scenarios.

Thermal sensation models link either environmental factors or physiological parameters to human thermal sensation voting on the scale between hot and cold sensations. There are several models available in the scientific literature and standards; however, the inconsistency between these models is very large of up to 7 units (entire standard thermal sensation scale). After thorough validation of the 7 most famous and frequently reported models we have revealed most reliable models and recommend using them within their application range.

Workflow using the modelling tools at EMPA

The practical use of the models is a sequence of steps that could be repeated in an optimisation loop for the desired effect (Figure 4). At first the concept of the garment can be created in CLO3D including the pattern design, fit and fabric choice. Once the garment is draped on the body, the air layers and contact with the skin can be determined. These parameters together with fabric properties are the most important inputs for the heat and moisture simulation model. In addition, a thermal scenario should be established including ambient conditions (temperature, wind, relative humidity) and presence of body movement. The heat loss from the individual body regions computed by this model is passed on to the human thermoregulation model to simulate thermal status of the body, i.e. distribution of skin temperature, presence and intensity of sweating, etc. Finally, the physiological parameters can be used to determine the thermal perception while wearing the designed piece of garment under assumed thermal scenario. The entire sequence of models or only part of it could be run as an optimisation loop to reach target values.

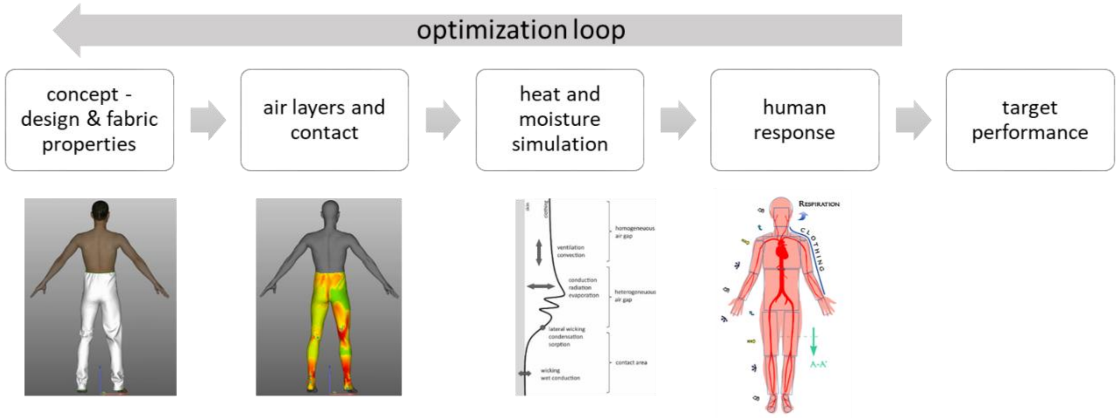


Figure 4: The sequence of steps while using the clothing, thermoregulation and thermal sensation models that could be repeated in an optimisation loop.

<u>Simulation using thermal manikins</u>

A range of thermal sweating manikins (whole body, head, foot, hand, torso) for characterizing ready wear products and prototypes and several instruments for characterizing fabrics and materials anticipated for wearing close to skin (moisture management tester, hot plate, contact angle, thermography, microcomputer tomography for wicking and moisture management tracing) are available at EMPA. These tools can be used to confirm the designed performance of the prototype in the realistic wear conditions especially if prototype complexity exceeds the capabilities of the simulation models. Secondly, the measurements could serve as a basis for comparison with competing products and quantify the development progress in subsequent prototypes. Newly developed materials can be also quickly tested based on small samples for best required performance. Finally, these instruments and associated experimental methods are used to validate the simulation outcome for selected cases.

3.2 Within close network to Re-FREAM

Who	Description (incl. Webpage)
Desktop printers	Cheap and portable FFF and SLA printers enabling to print various designs anywhere
Portable 3D scanning devices	3D scanning devices are always smaller, faster, more precise and work better. This allows e.g. an easier processing of information in digital tailor-made clothings.

3.3 Emerging technologies

Who/what	Description (incl. Webpage)
Desktop printers	Cheap and portable FFF, SLA and SLS printers enabling to print various designs anywhere
Portable 3D scanning devices	3D scanning devices are always smaller, faster, more precise and work better. This allows e.g. an easier processing of information in digital tailor-made clothing.
Yokai	Giving new functions to 3D printing, within the fashion industry, such as seams, stiffenings, decoration.
Enhancing the current 3D printing technologies	More precise, quicker, multi-colour, multi-materials,
Novel printing technologies	DLP, bioprinting, endless Y axis printin
Defextiles	Innovative printing method where the pattern of printing gaps caused by underextrusion forms a material, similar to how a textile is created

4 Mapping of additive manufacturing networks

Who	Description (incl. Webpage)
Addmanu http://www.addmanu.at/	addmanu is a national flag ship project for research, development und the establishment of additive manufacturing. There are four topics are defined as key technologies for additive manufacturing: lithograph based manufacturing LBF), Fused Deposition Modelling (FDM), selective laser welding (SLM) and the inkjet printing. These have from today's perspective the highest potential for applications and further developments. The project is funded by the Austrian Research Promotion Agency. The work of addmanu were launched in May 2015 and will run until April 2018th
Wear sustain https://wearsustain.eu/dashboards/home	The WEAR sustain network of pioneers in wearable tech is driven by passion about changing the way industry produces wearable products towards more sustainable and ethical wearables, e-textiles and smart textiles
3Dprint.com https://3dprint.com/272858/stratasys-3d-printing-polyjet-technology-continues-role-direct-textile-techniques/	3DPrint.com is a news organization dedicated to bringing you up to date on all the latest news from the 3D printing industry. They source and share the latest news and additive manufacturing industry stories through investigative reporting, interviews, and on-the-ground experiences through conferences, site visits, and hands-on information. Their professional team of writers are experienced and dedicated to their work.
3D printing industry https://3dprintingindustry.com/	3D Printing Industry (3DPI) is a global media company providing a dedicated resource for anyone interested in 3D printing and 3D scanning — two fields of technology that are rapidly growing in relevance and application across industrial and consumer sectors.
Austrian 3D-Printers against Covid19	Cluster of all 3D printing actors (private persons, companies, universities, institutes…) working together to provide assistance in the fight against the Covid-19 pandemic
3d printing masks for healthcare workers	Cluster of persons printing face masks to support healthcare workers.
3dhubs	Global urban manufacturing network, started out with local partners and non-commercial use, now it is more focussed on commercial use

5 Outlook

As mentioned in the introduction chapter above, this mapping of additive manufacturing ecosystem and network will contribute to the overall technology roadmap for urban manufacturing. Information collected within this deliverable will be taken up by respective work package, compiled with other puzzle pieces coming from other work packages and established on the Open innovation platform and reported in D7.4 in month 36 of the Re-FREAM project.