



Advancing industrial digital and green innovations
in the advanced textile industry through innovation
in learning and training

WP2 Romanian National Report



Co-funded by
the European Union

Project acronym:	ADDTEX
Project full title:	Advancing industrial digital and green innovations in the advanced textile industry through innovation in learning and training
Grant agreement no.:	101056303 — ADDTEX — ERASMUS-EDU-2021-PI-ALL-INNO
Responsible partner for deliverable:	CITEVE & TUS
Contributing partners:	All partners
Author(s):	INCDTP
Target Group(s):	Institution
Distribution level:	Partnership
Total number of pages:	16
Version:	Final
Language	English
Reviewed by:	Peer review
Status:	Final
Delivery date:	12.01.2023

Version control:

Number	Date	Description
1	12.01.2023	Final

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor the granting authority can be held responsible for them.”

Contents

Contents	3
1. Introduction	4
2. Technologies / innovation /documents /tools.....	5
2.1.1 Green transition.....	5
2.1.2 Digital transition	7
2.1.3 Smart transition	8
3. Existing Initiatives (Projects/strategies/documents/tools).....	9
4. Impact of the Green, Digital and Smart processes in the industry	12
4.1.1 Green	13
4.1.2 Digital.....	13
4.1.3 Smart.....	14
5. Initial and further education on advanced textiles.....	15
6. Conclusions	16

The information written in grey is for guidance. Please adapt or delete this information.

1. Introduction

INCDTP has the expertise and R&D facilities in textiles, clothing and leather processing, having a tradition of over 60 years in the area. INCDTP was involved in numerous R&D European and national projects, in various programs such as FP6 / FP7, H2020, Intelligent Energy Europe, CIP-Eco Innovation, ERA-NET (Crosstexnet, Manunet, SEE), EUREKA, bilateral cooperation, Erasmus+, COST Actions and EU Structural Funds. INCDTP is an active member of 4 innovative clusters in textiles and clothing and European research structures: ERA – European Research Area, EURATEX, TEXTRANET, and the Technology Platform for Women Scientists. INCDTP develops multidisciplinary applicative research in textiles, clothing, leather, footwear, and rubber consumer goods. The main research activities include the development of multifunctional products obtained by applying nanotechnology and microelectronics; protection equipment made of textile and leather for environments with different risk degrees; textile and leather products for increasing the quality of human health and life; design and manufacture of textile products with biomedical properties; computational modeling and numerical simulation, design, anthropometry and CAD/CAM pattern design, software products and methodologies for characterizing textile structures, modeling and processing of the textiles and clothing, environment protection, eco-technologies and wastewater treatment), special equipment for national defense and education (e-learning, courses) for textile domain and entrepreneurial skills development.

INCDTP developed the analysis of the textile & leather sector concerning the green-smart-digital technologies implemented in Romanian SMEs and HEI regarding:

- ➔ main green, smart and digital technologies that can be applied to the textile& leather industry;
- ➔ importance of implementing processes based on green, smart and digital technologies;
- ➔ importance of implementing and disseminating the aspects concerning green, smart, digital knowledge;
- ➔ already implemented green, smart, digital technologies in textile companies;
- ➔ existent courses about green, smart and digital technologies;
- ➔ specific needs for companies and HEI in the green, smart and digital economy;
- ➔ impact of COVID-19 in HEI: rethinking the courses and online methodologies to control & send information;
- ➔ impact of COVID-19 in SMEs: rethinking the production capacities, stocks and infrastructure for physical and online operations;
- ➔ interest of Romanian SMEs and HEIs to participate in courses about advanced smart/green/digital materials development;
- ➔ interest of Romanian SMEs and HEIs to participate in learning, research and innovation National and European projects.

The survey conducted by INCDTP between August and December 2022 involved mainly qualitative research methods (group activities and questionnaires dealing with open-ended questions, concepts, meanings and perspectives) in the framework of the desk & field research and living lab sessions.

In the framework of the workshops organized in situ or online (Meetup and living labs), we presented the ADDTEX project objectives, main activities, expected results and the advantages of the green, smart and digital technologies to companies and HEI. In addition, we asked them to define their past, actual and future roles in the context of the Green, smart and digital economy.

During the mentioned period, INCDTP developed 1 face-to-face workshop (Meetup) and 2 online workshops (living lab sessions) involving 14 SMEs, 2 HEI, 1 RES:

- **Meetup** - held in one session face to face (07.11.2022) with 5 companies and 1 RES;
- **The field research sessions** were organized on the same day as the Meetup (7.11.2022) with the same participants, respective in the introduction of the Living lab organized on 19.12.2022, when participated 2 HEI and 1 SME;
- In December 2022, have been organized **2 sessions of the Living lab** in the form of online workshops, when were involved 9 SMEs, 2HEI and 1 RES:
 - first Living lab (16.12.2022) involved the participation of 8 companies and 1 RES;
 - second Living lab (19.12.2022) involved the participation of 2 HEI and 1 SME.

During the Living lab, the ADDTEX project and the desk and field research results were presented to explain and understand the challenges for SMEs and HEI implementing new technologies and knowledge-based green, smart and digital. In addition, have been identified several training contents that could interest the companies and HEI.

This report is structured into six chapters with the following contents:

- ➔The first chapter presents a short introduction referring to the workshops organized by INCDTP;
- ➔The second chapter are presented the main technologies, innovations, tools and reports related to the green, smart and digital;
- ➔The third chapter presents the existing Romanian initiatives (project, strategies, documents and tools) related to the green, smart and digital approaches;
- ➔The fourth chapter presents the impact of the green, digital and smart technologies integrated into the industrial textile processes. In addition, it presented the impact of COVID-19 on the company’s activities;
- ➔The fifth chapter presents the actual level of education in green, smart and digital concepts and the future perspective. In addition, are presented several activities impacted by COVID -19;
- ➔The sixth chapter succinctly presents the conclusions of the Romanian survey.

2. Technologies / innovation /documents /tools

Digitalization, integration of smart things and sustainable development are priorities for the Romanian research and innovation sector. In Romania, the INCDTP and Romanian universities having textile faculties/departments have numerous initiatives in implementing digitization, smart and green technologies and methods for innovative learning. The future targets include reducing carbon footprint and integrating digital and smart things (electronics) using IoT. The following tables present the Romanian initiatives contributing to the green, smart and digital transitions.

2.1.1 Green transition

Table 1. Green

Technology/innovation/Changes	Description	Processes impacted by the technology	Examples (links..)
Green Report -Sustainable Fashion	The initiative presents several production methods of the materials that should be changed. In addition, it specified the fact that consumers should change their behaviors related to fashion products. These fashion products should be made with materials certified according to the Global Organic Textile Standard (GOTS) or OEKO-TEX.	-the production processes; -consumers behavior;	Asociatia Green Revolution green-report.ro/despre-moda-sustenabila-cu-altrntv-trebuie-sa-schimbam-metodelele-de-productie-a-materialelor-si-comportamentele/
Green Global – Collect waste	The Green Global Romanian company can collect the textile waste to be reused as raw materials after laborious processes and fibers separation.	-raw materials management; -production optimization; -collect/select textile waste;	Green Global Company www.greenglobal.ro/colectare-deseuri/colectare-deseuri-textile/
ALECOTERMO	The national project ALECOTERMO aims to use	-reuse the textile waste;	INCD URBAN-INCERC Bucharest

	nonwoven 3D panels made of textile waste, vegetable and wool fibers as thermal insulation.	-manufacturing of 3D nonwoven panels for building insulation and energy efficiency	www.incd.ro/wp-content/uploads/2021/11/Raport-activitate-ALECOTERMO.pdf
EcoLabel	SMEs can achieve the European Ecolabel and it is a guarantee the SME reduces the harmful chemicals	-reducing the use of substances with a negative effect on water, air, soil -reducing the use of substances with a high risk of causing carcinogenic, allergic effects.	S.C. SOFTEX SRL, Polyester Batting, License number RO/016/001 www.mmediu.ro/articol/lista-operatorilor-economici-care-au-obtinut-eticheta-ue-ecologica-actualizare-august-2022/5479
WhyWeCraft	<i>WhyWeCraft</i> ® is a project developed under the Cultural Intellectual Property Rights Initiative® and encourages the Co-Design between artisans and designers.	-cultural sustainability in fashion	www.whywecraft.eu
STRATTON	The <i>STRATTON</i> project pursues an innovative approach and proposes a demonstration model of a rapid intervention naval unit made of a complex composite reinforced with a woven textile structure, with high-tech features imposed by the complex conditions of use in the open sea, in order to maximize the efficiency of the intervention in a disaster case.	-recovery of pollutants from water (hydrocarbons) -temporary vertical storage and horizontal transport of the water-hydrocarbon mixture	www.incdtp.ro/STRATTON/index.html
Enviro-Tex-Design	The <i>Enviro-Tex-Design</i> project aims to develop a cleaner product with fast development through 3D virtual design tools	The aim is to improve the functioning of the single market for chemical substances, through a unitary approach, at the level of the European Union, to the system of risk assessment and registration.	www.envirotexdesign.eu
SET, Save Energy in Textile SMEs	The project SET allows textile SMEs to improve their energy efficiency and achieve quantifiable economic benefits through efficient use of resources	The aim is to evaluate and improve energy efficiency in textile SMEs along the value chain in the textile industry: spinning/weaving/knitting/finishing.	www.incdtp.ro/pdf/proiecte/SET_ro.pdf
SESEC	The project SESEC aims to use efficient energy in the clothing industry.	-production process for the clothing industry.	www.incdtp.ro/pdf/proiecte/SESEC1.pdf

POLYRISK	Understanding exposure and toxicity of micro- and nano-plastic contaminants in humans.	-investigation of human exposure to MNP and their potential toxic effects; -health evaluation of workers in the textile industry. -understand key mechanisms of MNP toxicity in vitro; -find biomarkers of toxicity in blood and saliva.	www.polyrisk.science
LIFE REWEART	100% circular economy manufacturing process for vegan-organic-recycled footwear	Sustainable production processes through reducing carbon footprint by using organic or recycled fabrics (yarns, woven or nonwoven structures developed by recycled fibers) and reduce the energy and water consumption	www.life-reweart.eu www.youtu.be/g6M1PYmUHKI
OLIPO	The project OLIPO aims to implement recycling strategies for olive oil extraction process waste (wet olive pomace) to be applied in the leather industry	-reevaluation of waste from olive processing (Wet Olive Pomace-WOP); -reuse in the leather processing sector	www.incdtp.ro/icpi/pdf/pr-oiecte/Manunet_OLIPO-RO.pdf
InSuLa	The project InSuLa aims to develop innovative materials and technologies for sustainable manufacturing for automotive	- development of novel safe and non-toxic nanocomposites	www.incdtp.ro/icpi/pdf/pr-oiecte/InSuLa.pdf

2.1.2 Digital transition

Table 2. Digital

Technology/innovation/Changes	Description	Processes impacted by the technology	Examples (links..)
CLOTH project Fashion Platform	The project CLOTH (COSME H2020), involving the Romanian partner Asociata Iconic Cluster, aims to improve cooperation by creating a cluster alliance within the Fashion sector to support SMEs in the digital and sustainable transformation	-international cooperation; -digital skills development; -helping in the transition to green & digital fashion -networking.	Cloth Project www.clothproject.eu Fashion Platform https://fashion.clothproject.eu/networking

Gemini AutomART®	Gemini provides a software solution for the Digital Printing of Textile products.	-production optimization generates saving of up to 30% on raw materials; -decorating time reduced by 60% while saving up to 30%	Automart https://gemicad.com/products/automart
DigiTEX	The project aims to create digital tools for learning about electronic components integrated into textiles	-development of an e-learning platform; -software tutorials for integrating electronics into textiles	www.e-digitex.eu www.digitex-moodle.eu/moodle/
OptimTex	The project aims to develop software tools for creatives	-development of software tutorials for students	www.optimtex.eu www.youtube.com/channel/UCMOSSavcYoiX2ygrIKx7gGg www.advan2tex.eu/portal/pluginfile.php/4178/mod_resource/content/2/User%20manual%20OptimTex02.pdf
Digital Fashion	Erasmus+ Digital fashion project aims to organize collaborative online international learning within partner institutions, other higher educational institutions and industrial enterprises of joint expertise.	-develop a training platform for fashion design by 3D Virtual Garment Fitting.	www.digitalfashionproject.eu

2.1.3 Smart transition

Table 3. Smart

Technology/innovation/Changes	Description	Processes impacted by the technology	Examples (links..)
RESET	The Interreg Europe RESET project aims to present an overview of smart textiles' good practices and new ways of production	-learning about smart textile development; -experience improvement through good practices.	www.youtube.com/watch?v=X6CsaBe14xk
Skills4Smartex	The Erasmus+ project Skills4Smartex aims to increase knowledge, improve skills and employability of VET students in STEM-related fields such as smart textiles	-learning methods-based STEM for smart materials -educational content development related to smart textiles materials and evaluation methods.	www.skills4smartex.eu www.skills4smartex.eu/instrument.php
TEXTRA	The Erasmus+ project TEXTRA aims to support innovative and advanced materials development	-learning methods; -solving the SMEs' challenges through	www.texstra.eu/virtual-internships

	and to support learning-based projects through virtual internships	projects in the framework of the virtual-internships	
DigiTex	The project Erasmus+ DigiTex aims to foster the co-creation of textiles with integrated sensors, actuators or EM shielding systems	-co-design of the smart textile products (e.g., protective equipment for fire, water, chemicals having integrated sensors, actuators); -defining the adequate advanced textile materials for sensors, actuators, EM shields, photonic applications and batteries.	www.e-digitex.eu

3. Existing Initiatives (Projects/strategies/documents/tools)

INCDTP is involved in several initiatives that aim to contribute to green, smart and digital transitions. The most recent initiative is the national project 3D-WearIoT, where INCDTP will be involved for four years (2023-2027). The project 3D-WearIoT aims to develop smart functionalized materials for sensors, actuators, EM shields and supercapacitors for healthcare, security, protection and wellbeing. This represents an actual initiative to smart (electronic components-based textiles), digital (integration of these components in demonstrator-based IoT; using signal processing and data analysis) transition taking into account the reduction of the carbon footprint through using the processes and materials previously supposed to the control of the processes by life cycle inventory for each material and processes and impact evaluation by comparative LCA (life cycle assessment). In addition, INCDTP was a coordinator or partner in Erasmus+ projects aiming to develop digital learning tools for smart materials (Advan2tex, TexMatrix, Skills4Smartex, Optimtex, DigiTex) or advanced functional material (TEXSTRA, FOSTEX). More information about the main documents, projects, and companies related to the green, digital and smart transition are presented in the following sections:

→ **Projects and documents with a focus on the advanced materials targeted on the green:**

- **Documents:**

- ✓ **EU Greendeal, concerning the circular economy**,¹ presents that the new business models should stimulate the sorting, reuse and recycling of textiles allowing consumers to choose sustainable textiles. According to the Greendeal pact, the garment should be designed to increase durability and wearability time.
- ✓ According to the **Action plan for circular economy**^{2,3} only 1% are recycled into new textiles. The EU Strategy for Textiles will include eco-design measures to reuse or recycle textiles into new products. The textile industry is a massive consumer of water, energy and chemicals, and in equal measure, generates GHG emissions.
- ✓ The article '**Changing how we produce and consume: New Circular Economy Action Plan shows the way to a climate-neutral, competitive economy of empowered consumers**'⁴ presents the necessity to adopt the new EU Strategy for Textiles to increase the competitiveness and innovation in textiles that can be reused in order to achieve in 2050 the climate neutrality.
- ✓ **Romanian PNRR** considers the aspects concerning textile waste that should be separately collected and recycled because now it is not organized as a centralized form of collecting textile waste.

¹https://ec.europa.eu/commission/presscorner/detail/ro/fs_20_437

²https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf

³<https://www.europarl.europa.eu/news/ro/headlines/society/20210128STO96607/cum-doreste-ue-sa-obtina-o-economie-circulara-pana-in-2050>

⁴https://ec.europa.eu/commission/presscorner/detail/en/ip_20_420

- ✓ According to **ECO Synergy**⁵, which develops awareness and greening activities, by recycling one ton of textiles, greenhouse gas emissions are reduced by 3.6 tons, and for the recycling of cotton textiles, approximately 20,000 liters of water needed for cotton cultivation and growth can be saved.
- ✓ The **European Union Strategy for Sustainable Textiles**⁶ presents how textile products on the EU market will no longer contain hazardous substances and will be produced in compliance with social and environmental rights. In addition, producers will take responsibility for their products along the value chain, including their transformation into waste.
- ✓ The document **Sustainable and Circular Textiles by 2030**⁷ presents the critical actions in Textile Strategy, such as designing sustainable requirements for textiles, digital product passwords, using greenwashing, reverse overproduction and overconsumption.
- ✓ The document **EU strategy for sustainable and circular textiles**⁸ involved numerous stakeholders in defining the preparation of the consultation strategy through online workshops and surveys by focusing on minimal design for ease of recycling and integration of recycled content.
 - **Tools:**
- ✓ The **recycling map platform ‘Harta Reciclării**⁹ is the first national, participative and educational platform where the community promotes the reduction, reuse and recycling of waste of all types, including textiles wastes and plastics. According to this website, 95% of textiles can be reused or recycled, but most textile waste is sent to cement factories to be co-incinerated.
 - **Companies:**
- ✓ **Green Global**¹⁰ is a Romanian company that can collect textile waste to be reused as raw materials after laborious processes and fibers separation.
- ✓ **Several companies (H&M)** present on the Romanian market organized initiatives to collect textiles, but the amount is reduced.
 - **Projects:**
- ✓ **Project RESET Interreg Europe**¹¹, in which INCDTP was involved as a partner, promotes a sustainable approach to production in the textile and clothing sector.
- ✓ **Project ECOPRINT 3D**¹², coordinated by INCDTP-ICPI, aims to use recycled polyethylene (LDPE, HDPE), modified starch and functionalized nanopowders (ZnO, OMMT) for the 3D printing of new products.
- ✓ **Erasmus+ Project ECOSIGN**¹³, having as Romanian partner IBA, promotes textile eco-design.
- ✓ The **RESYNTEX**¹⁴ project generated a new circular economy concept for the textile and chemical industry.
- ✓ **Erasmus+ EcoTex Project**¹⁵, having as a Romanian partner the Technical University “Gheorghe Asachi” of Iasi, aims to implement circular economy techniques in the Textiles Industry to improve competitiveness in the textiles sector based on the development skills and competencies and to define the professional profile for the sustainability expert (SME’s) and to increase the interest in the implementation of the sustainable manufacturing strategy.

⁵ <https://ecosynergy.ro/reciclare-textile-cum-se-poate-face-si-cum-influenteaza-mediul-inconjurator>

⁶ www.eureau.org/news/656-eu-strategy-for-sustainable-and-circular-textiles#:~:text=The%20EU%20Strategy%20for%20Sustainable,includi%20when%20they%20become%20waste.

⁷ https://www.interregeurope.eu/sites/default/files/2022-05/Textiles_Factsheet_EC.pdf

⁸ Synopsis report - Online Public Consultation on the EU Strategy for Sustainable and Circular Textiles, online available: environment.ec.europa.eu/publications/textiles-strategy_en

⁹ <https://hartareciclarii.ro/material/cum-colectam-hainele>

¹⁰ <https://www.greenglobal.ro/colectare-deseuri/colectare-deseuri-textile/>

¹¹ <https://projects2014-2020.interregeurope.eu/reset>

¹² <https://incdtp.ro/icpi/proiecte.html>

¹³ <http://www.ecosign-project.eu>

¹⁴ <https://knowledge-hub.circle-lab.com/AfricanCAT/article/9095?n=RESYNTEX-innovation-in-textile-recycling>

¹⁵ <http://www.ecotexerasmus.eu>

- ✓ The **Erasmus+ Fashion DIET**¹⁶, involving the Romanian partner Technical University “Gheorghe Asachi” of Iasi, promotes sustainable fashion curriculum at Textile Universities in Europe.
- ✓ **TreeToTextile project**¹⁷, based on 3 partners (H&M, IKEA and Stora Enso), aims to develop a new fiber type using renewable forest materials and transforms cellulose into textile fibers. The production process involves reduced energy and chemical consumption, making it more sustainable and cost-effective than standard production.

→ **Projects and documents with a focus on the advanced materials targeted on Digital:**

- **Projects:**
- ✓ **Erasmus+ Optimtex**¹⁸, coordinated by INCDTP, aimed to develop software tools for textile creatives.
- ✓ **Erasmus+ DigiTex**¹⁹, coordinated by INCDTP, generates digital learning technologies to boost innovation in medical, protective, sensorial and smart textiles in the context of the digital economy.
- ✓ **Erasmus+ Digital Fashion**²⁰, coordinated by INCDTP, aims to develop methodologies for teaching and learning digital fashion co-design in a virtual environment.
- ✓ **Erasmus+ TexMatrix**²¹, coordinated by INCDTP, aims to foster the use of ICT in innovation processes within textile enterprises.

→ **Projects and documents with a focus on the advanced materials targeted on Smart:**

- **Projects:**
- ✓ **Erasmus+ HACKTEX**²² project, involving the Romanian partner the Technical University “Gheorghe Asachi” of Iasi, aims to develop a training programme in smart textiles;
- ✓ **Erasmus+ Skills4Smartex**²³, coordinated by INCDTP, aims to generate courses about smart textiles for the innovative field of the textile industry.
- ✓ **Erasmus+ TEXSTRA**²⁴, coordinated by INCDTP, developed a survey about advanced materials need analysis for SMEs and HEI and courses in advanced materials technologies.
- ✓ **Erasmus+ Fostex**²⁵, involving INCDTP as a partner, established two advanced textile materials centers in Jordan and Morocco, respectively, upgraded two existing ones in Jordan and Morocco and developed courses for advanced materials and standardization.

→ **Documents related to COVID-19 Impact**

Related to the **COVID-19 impact on the textile industry** in the **platform ROTEX**²⁶ exists a **report**²⁷ **generated by FEPAIUS** (FEDERATIA PATRONALA A TEXTILELOR, CONFECTIILOR SI PIELARIEI) Romania that mentions the negative impact on the textile industry materialized in stagnations in production, approximately 30% of the export capacity being closed, and the remaining of 70% worked at a capacity of 20%.

From this report, we can mention the following **negative impact generated by COVID-19 on production capacity, raw materials, employers and funding:**

1. Difficulties in supplying raw materials and accessories due to the transport capacity reduction on the Romania-Italy, China route, as well as the suspension of many activities of Italian producers.
2. Reduction or cancellation of orders, especially from customers based in Italy.

¹⁶ <https://fashiondiet.eu>

¹⁷ <https://treetotextile.com>

¹⁸ <http://www.optimtex.eu>

¹⁹ <https://e-digitex.eu>

²⁰ <http://digitalfashionproject.eu>

²¹ <http://www.texmatrix.eu>

²² <https://hacktex.eu>

²³ <http://www.skills4smartex.eu>

²⁴ <https://www.texstra.eu>

²⁵ <https://fostexproject.eu>

²⁶ <http://rotexplatform.ro>

²⁷ <http://rotexplatform.ro/documente/descarca/b754ffbe26cc49a0319d2eb9/bibliografie>

3. Failure to comply with production planning and the decrease in production value due to supply delays (up to 1 month) with raw materials from the areas affected by the coronavirus.
4. Traditional customers were late in launching the orders they had foreseen.
5. Delays in payments, from 30 days to 45-50 days or even more.
6. Absence of staff from the company due to the epidemiological crisis.

→ **The mitigation measures** used to reduce the negative impact of the COVID-19 pandemic were:

1. The use of technical unemployment with funds from the unemployment aid to maintain the workforce;
2. Extending the period of technical unemployment from 30 to a minimum of 90 days;
3. Postponing the payment of payroll taxes or even reducing them, as in Italy and the US.
4. Exemption from taxes and salary contributions for three months for those employed during this period in this industry.
5. Supporting the institution of medical quarantine leave in the situation where the deliveries of raw materials are stopped.
6. Rescheduling rates from all banks operating in Romania, especially for investment loans in this industry.
7. Flexibility of overtime compensation.
8. For situations of incapacity for work due to the current epidemiological crisis, the state should make the settlement of medical leaves in whole without the employer being obliged to bear the first five days of each initial leave.
9. Reactivating the law by which Eximbank subsidizes 50% of exporters' interest.
10. Redefining the "situation of force majeure" by including these crises generated by the "Epidemic."

4. Impact of the Green, Digital and Smart processes in the industry

The specialists (engineers, managers, administrators) from several companies and researchers from INCDTP meet to discuss and respond to the following three questions taking into account the experience related to their company.

- **What does innovation relevant to green mean for companies and where is innovation in the processes implemented? What target impacts need to be achieved?**

The companies answered that the main green innovations were using recyclable materials (textile raw materials from recycled materials, lining from recycled materials, antibacterial treated insole coverings) and the implementation of selective collection and recycling systems for textile waste.

- **What does innovation relevant to smart mean for companies and where is innovation in the processes implemented? What target impacts need to be achieved?**

The companies believe smart innovation involves robotic lines for specific technological processes, new finishing technologies, embroidery, and digital printing on textiles.

- **What does innovation relevant to digital mean for companies and where is innovation in the processes implemented? What target impacts need to be achieved?**

The companies considered that digital innovation would consist of automating the process of detecting defects in raw materials or products, using semi-automatic workstations to produce military uniforms, using computer-aided design and 3D modeling and the virtual environment. Also, most companies believe that it is necessary to implement new ICT technologies, creating innovative products with high-added value and national and global demand.

The existent green, digital and smart technologies/solutions already implemented by several companies are:

→ **Green:**

Several companies already use recycling and waste management (selective collection of textile waste), energy from renewable resources (photovoltaic panels) and hybrid cars for product transport.

→ **Digital:**

The companies already use fleet telematics system-based GPS, video surveillance technologies of production lines, automatic tailoring machines, access to databases containing digitized patterns in the company, 3D design of shoe samples and computer-assisted design of patterns (GERBER).

→Smart:

The companies specified that they use the 3D design of shoe samples, programs for management, administration and production (ERP) and are interested in developing customized products (e.g., shoes for diabetics).

The companies involved in this survey have a staff consisting of engineers, technicians and qualified workers.

4.1.1 Green

Table 4. Green

Functional areas of the company	Technology/innovation/Changes	Knowledge needed to perform the process	Priority Training Topics to be addressed
Production	Collection of textile waste	-	-Importance of collecting textile waste for recycling and reuse in new products

4.1.2 Digital

Table 5. Digital

Functional areas of the company	Technology/innovation/changes	Knowledge needed to perform the process	Priority Training Topics to be addressed
Production area	Acquisition of new machines Reduce energy consumption by using renewable energy sources (solar energy)	-Knowledge about conductive materials and electrical/electronics integration -subcontract this service (solar energy panels integration) to specialized companies	Technical knowledge (processes, technology, conductive materials (carbon, graphite)) ²⁸
Purchasing Department	System computer update	Specialist in public purchasing	ERP system utilization
Finance Department	System computer update	Financial specialist	ERP system utilization
Sales Department	System computer update	Specialist on sales	Electronic sales e-commerce ERP system utilization
Logistics	New systems for logistics	Logistics Specialist	Logistics ERP system utilization
Design/Prototyping	-3D simulation and footwear prototyping -3D simulation and garment prototyping	-Pattern design -3D modeling -software specialized for 3D modeling& simulation	3D Digitalization 3D virtual prototyping
Production management/surveillance	-AI-based system for production management of defect detection	-Software engineer -Engineer with knowledge of software for production management	-Production Management; -Textile defects; -Importance of AI-based systems and advantages

²⁸<https://thermaltechnology.ro/tehnologia>

4.1.3 Smart

Table 6. Smart

Functional areas of the company	Technology/innovation/changes	Knowledge needed to perform the process	Priority Training Topics to be addressed
Production	New smart technologies and materials for the development of footwear for diabetics	-Pattern design; -Patient particularities; -3D pattern design and printing of personalized shoes	-3D pattern design using specialized software

At the question ‘**What are the main challenges you perceive concerning the transition to the green, digital, smart economy?**’ the companies provided the following answers:

- optimal use of recycled materials;
- the use of solar panels;
- robotization of production lines for specific processes;
- obtaining new raw materials;
- the use of intelligent systems based on AI;
- implementation of digital systems for making products (tailoring, printing);
- implementation of digital technologies;
- the purchase of modern machines that will help us in the production process and consume little electricity and auxiliary energy;
- the purchase of a high-performance IT system;
- intelligent waste selection;
- absorption of the necessary funds for modernization to achieve sustainable production and digitization;
- intelligent defects detection-based video/image processing and AI.

At the question ‘**What is my role? What are my options in an ecosystem based on green, digital, intelligent transition?**’ the companies provided the following answers:

- user of ecological materials and products based on AI;
- the option is the sustainable implementation of digital technologies
- the option is to obtain quality products with low energy consumption;

In addition, the companies specified that problems caused by the COVID-19 pandemic were:

- problems with the supply flow of raw materials;
- difficulties in organizing the work schedule;
- decrease in finished product orders

The solutions found to reduce the negative impact due to COVID-19 pandemic were:

- supply with excess stocks;
- the decrease in finished product orders was challenging to manage and the company tried to find new customers unaffected by the COVID-19 pandemic.
- restriction of activity.

5. Initial and further education on advanced textiles

- Identification of strategies, documents, programmes, tools (i.e. systems of qualification, educational platforms), projects at EU, national and regional level with a focus on the advanced materials targeted on green, smart, digital knowledge and impact of COVID 19 in the area of education in VET and HEI

According to the 'REFERENCING THE ROMANIAN QUALIFICATIONS FRAMEWORK TO THE EUROPEAN QUALIFICATIONS FRAMEWORK'²⁹ report, in Romanian higher education, qualifications are linked to the European Credit Transfer System (ECTS) credit structure, which is mandatory for all study programs of higher education institutions in Romania to apply.

The European Credit System for Vocational Education and Training (ECVET)^{30, 31} aims to ensure compatibility between different education and vocational training systems in Europe, promoting transnational mobility and access to lifelong learning.

In Romania, there are already several projects aiming to help in adopting digital (Vir2Tex³², Digitex) or smart skills (Hacktex, Skills4Smartex, Digitex), as well as green skills (Fashion Diet, CircuTex).

The Erasmus+ '**EXTRO-SKILLS**'³³ involves designing and implementing a new ICT-based training program providing fashion export marketing skills.

The Erasmus+ **Vir2Tex** aimed to use virtual reality (VR) for learning materials enhanced for distance education about textile production from fiber to clothing.

The Erasmus+ **Fashion Diet** aims to integrate sustainable fashion design, production technologies and sustainable orientation of the fashion market.

The Erasmus+ project '**Digitalising VET: The Flipped Work-Based Learning**' aims to facilitate the digitization of VET and work-based learning³⁴ and equip VET providers with the necessary competencies to use this model.

The Erasmus+ **CircuTex**³⁵ project aims to enhance the sustainability competencies of HEI students and educators in fibrous composites and technical textiles.

The COVID-19 pandemic has generated the suspension of face-to-face courses and the transition to online learning, which has been a challenge for students and teachers to transfer knowledge in electronic format and counteract the negative effects generated by the lower attention of students, illnesses and adaptability initially low on both sides. According to the study 'University education in Romania in the context of the Covid-19 pandemic: students' experiences'³⁶, approximately 59% of students rated online courses as worse or more than face-to-face. This negative rating is related to privileged students' dissatisfaction with the large amount of individual work required for online courses.

The textile and leather companies in Romania are micro, small or medium enterprises and they consider that training in digital, intelligent and green production is necessary. However, at the same time, they are necessary funds, projects and investing in new technologies to create performant products.

Companies participating in the field research and Living lab sessions said there is a lack of information and courses regarding implementing new digital solutions for sustainable production, defect recognition, waste selection and

²⁹https://europa.eu/europass/system/files/2022-05/Romanian_Referencing_Report%5B1%5D.pdf

³⁰<https://www.anpcdefp.ro/ecvet>

³¹https://www.cedefop.europa.eu/files/ECVET-Flyer_Toolkit_web.pdf

³²<https://vir2tex.yasar.edu.tr>

³³<http://textilehouse.co.uk/innovations-and-projects/erasmus-extro-skills>

³⁴<https://flippedvet.bda.lv/mod/page/view.php?id=32>

³⁵<https://circuitex.eu>

³⁶[https://icf-fri.org/wp-](https://icf-fri.org/wp-content/uploads/2020/04/%C3%8Env%C4%83%C8%9B%C4%83m%C3%A2ntul_universitar_din_Rom%C3%A2nia_%C3%AEn_contextul_pandemiei_COVID-19_Experien%C8%9Bele_studen%C8%9Bilor.pdf)

[content/uploads/2020/04/%C3%8Env%C4%83%C8%9B%C4%83m%C3%A2ntul_universitar_din_Rom%C3%A2nia_%C3%AEn_contextul_pandemiei_COVID-19_Experien%C8%9Bele_studen%C8%9Bilor.pdf](https://icf-fri.org/wp-content/uploads/2020/04/%C3%8Env%C4%83%C8%9B%C4%83m%C3%A2ntul_universitar_din_Rom%C3%A2nia_%C3%AEn_contextul_pandemiei_COVID-19_Experien%C8%9Bele_studen%C8%9Bilor.pdf)

[WP2. \[Romanian National Report\]](#)

recycling. They also stated insufficient information about advanced materials and the technologies required to produce them. They also expressed concern about the cost of such new technologies for producing smart materials and insufficient funding for equipping with advanced technologies/utilities or purchasing digital solutions.

6. Conclusions

Following discussions in the meetup/living labs sessions with companies and HEIs about ADDTEX project objectives and results, the participants expressed a real interest in courses and collaborations in new projects aimed at the smart, digital and green transition. Even if, for researchers and universities, this green-digital-smart transition is seen as generating new products, technologies, jobs and research or innovation projects, the company representatives specified that these investments in new technologies or human resources to produce smart, advanced materials or products must also be supported by market demands for these products. In some cases, they viewed this transition with slight skepticism, considering the insufficient financing versus the costs necessary to invest in means of production that should be amortized in time if there is a demand for those products.

The meetings (Meetup and Living Labs) facilitated the exchange of ideas and the acceptance of common points of view consisting of the need to improve soft skills (writing projects/patents, marketing analysis) of employees in companies and the development of new textile materials by using groups of specialists for the co-design and co-creation of new materials and products that involve a multidisciplinary and interdisciplinary approach.