



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

## **WP2 Czech National Report**

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## 1. Introduction

The textile industry in the Czech Republic (CR) maintains an important position despite its decreasing in the past (between 2004 and 2021 a decrease of 51%). However, the slowdown was accompanied by restructuring and a focus on the technical textiles segment, which has the potential for higher added value and applications in several areas with specific needs - as an example automotive, healthcare, social personal services, construction, agriculture, special clothing, etc. The specific needs of these sectors led to the ever-higher demand for knowledge in the field of electrical engineering, physics, chemistry, biology, IT technology, and their reflection into new functional materials, technologies, etc., i.e. the development of **multidisciplinarity**. The perspective specialization of the Czech textile industry are nanofibers and nanotechnologies.

A significant presence of the textile industry in the CR remains in the NUTS II Northeast, as well as South Bohemian and South Moravian regions. These regions specialize in the textile industry as part of their RIS 3 strategies. High relevance is the solution of the **circular textile industry** because the CR is among the **10 largest producers of textile waste** (Italy, Germany, France, Belgium, Poland, the Czechia, the Netherlands, Portugal, Spain and Austria), and dominates in the production of textile waste per inhabitant (12 kg compared to the EU average of 5 kg/inhabitant).

Gap analysis processing procedure:

- **Desk research at the EU and national level** - industry, VET and HEI education, WBL methods and COVID impact
  - we studied essential strategic EU documents and studies relevant to our topics in twin transition during July to September. Advanced textile materials require advanced knowledge, so we also studied the relevant research and innovation trends set by ETP, as well as RIS3 specializations. This this part was directed to the smart topic. An EU report was prepared. A subcontract was carried out for desk research in the national HEI education section, the result of which is a report. The author is the textile faculty of the Technical University in Liberec - the only textile faculty in the Czech Republic.
- **Meetup and industry field research**
  - **MeetUp** was held in presence on 4<sup>th</sup> October 2022 with 9 companies, 3 VET and 1 HEI, **industry field research** took place on the same day. There was a discussion on the results of the desk research, companies expressed their view on the weak and strong sides of the advances textile industry, identified the main challenges and threats. At the same time, they formulated the knowledge that these challenges require. The SWOT analyse was developed.
- **VET and HEI field research**
  - the education field research was held online on 21<sup>st</sup> November 2022, 3 VET and 1 HEI took part in this session. We discussed results of desk research and current offer of educational modules, WET education methods and the reflection of COVID. Representatives of education expressed a great interest in deepening cooperation with companies and a detailed discussion about the needs of the company in connection with the twin transition and the need for advanced knowledge and skills
- **Living Lab**
  - Joint meeting on 23<sup>th</sup> November gathered 7 companies (10 representatives), 2 VET (4 representatives) and 1 HEI (3 representatives) to share the results achieved in the desk and field research and to identify the main contents that companies would like to see addressed in training offer, as well as to understand the challenges that education entities face in preparing training offer in green, digital and smart.

This report is divided into six chapters in which we present the main results achieved in the different phases of the desk and field research. Each of the chapters represents one of the phases of finding out information to determine the gaps, which will be the focus of further project activities.

From identifying the main trends and challenges that companies must respond to, to mapping existing projects and activities, i.e. what knowledge companies have, to identifying the current education offer, identifying gaps, identifying barriers and schools' needs. The output is the main topics that are proposed for the upcoming MOOC course as well as other tools for the development of knowledge and skills in companies.

## 2. Technologies / innovation /documents /tools

The technologies and tools identified as the most important technological changes that will affect the textile industry in the region are exposed in this chapter. The results summarised in the tables of the chapters 2.1, 2.2 and 2.3 referred to green, digital and smart transitions, respectively, are the combination of the analysis of the global trends, strategic framework and feedback received by the Czech industry, together with the VET and HEI collaborating.

Companies perceive the trend of sustainable development as the main challenge, they consider digital technologies as a means that can significantly contribute to green goals. However, all the companies involved also emphasized problems in the area of energy intensity and disproportionate cost increases. They often mentioned, for example, that connected with eco-design and product planning with regard to environmental aspects, it must also be connected with modeling the energy intensity of production processes. The area of advanced textile materials must therefore be closely linked with the area of advanced textile engineering and production technologies.

Particular technologies/innovation/changes are presented, if possible, in the sequence of the circular model

### 2.1 Green transition

Technology/ innovation/ Changes	Description	Processes impacted by the technology	Examples (links..)
Life Cycle Assessment (LCA) (and other Life Cycle analysis)	The essential part of the circle economy, analysis of all the environmental impacts associated to a product or a process. In these cycles are included inputs such as materials, energy, transport, communication with the customer, sales, end-of-life phase of the product and its recycling, waste as a resource for further production. This process takes into account outputs like greenhouse gas emissions, water treatments, chemicals by-products. This methodology is still incipient in industry.	All the process, including the reuse, recycle and end of life behavior.	<a href="https://cordis.europa.eu/project/id/628">https://cordis.europa.eu/project/id/628</a>  <a href="https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022D2508&amp;qid=1671517820694">https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022D2508&amp;qid=1671517820694</a>
Ecodesign	Ecodesign is a systematic process of designing and developing a product and manufacturing processes, which, in addition to classic features such as functionality, economy, energy and virgin resources, safety, ergonomics, technical feasibility, aesthetics, etc., places great emphasis on achieving a minimum negative impact of the product on the environment, from the point of view of its entire life cycle	All the process, including the reuse, recycle and end of life behavior.	<a href="http://www.ecosign-project.eu/wp-content/uploads/2018/09/TEXTILE_UNIT08_EN_lecture.pdf">http://www.ecosign-project.eu/wp-content/uploads/2018/09/TEXTILE_UNIT08_EN_lecture.pdf</a>
Water reduced processes	Water consumption and contamination is one of the main problematics in the textile industry. Many textile processes, such as cleaning, bleaching, finishing, dyeing and printing are one of the most consuming industrial processes.	Cleaning, dyeing, printing, finishing,... processes	<a href="https://cordis.europa.eu/project/id/642494">https://cordis.europa.eu/project/id/642494</a>

PFAS chemicals, microplastics	Perfluorinated substances are a significant burden on the environment because they are difficult to degrade	Design of product, use of the product, its maintenance (e.g. washing) recycling of waste	<a href="https://sustainfashion.info/the-use-of-perfluoroalkyl-and-polyfluoroalkyl-substances-pfas-in-textiles/">https://sustainfashion.info/the-use-of-perfluoroalkyl-and-polyfluoroalkyl-substances-pfas-in-textiles/</a> <a href="https://www.gore-tex.com/sustainability/protect-the-planet/reduce-chemical-impacts">https://www.gore-tex.com/sustainability/protect-the-planet/reduce-chemical-impacts</a>
Collecting and recycling technology	Compulsory collection of textiles will be introduced from 2025, it is necessary to develop sorting lines, recycling technologies, efficient sorting of textiles according to composition, color, or other attributes	Waste as a resource	<a href="https://www.fibersort.com/">https://www.fibersort.com/</a>
Clothing as a service	a business model that allows you to return the clothing after it has been worn to the seller (manufacturer), who then recycles the clothing (material), has a greater overview of the material, recycling is facilitated	Waste as a resource	<a href="https://mudjeans.eu/">https://mudjeans.eu/</a>

## 2.2 Digital transition

Technology/innovation/Changes	Description	Processes impacted by the technology	Examples (links..)
Digital collaboration platforms	Digital environment for Factories 4.0 collaboration and the development of business models in cross-industry business in a circular economy environment	All processes of circular economy	<a href="https://www.digiprime.eu/project/">https://www.digiprime.eu/project/</a>
Virtual design of garments	CAD/CAM, AI software tools for 3D modelling of apparels, fashion	Design of product, production, communication with customer	<a href="http://www.inventex.eu/en/oferta/inventex-fds-virtual-garment-and-textile-designing-tool/">http://www.inventex.eu/en/oferta/inventex-fds-virtual-garment-and-textile-designing-tool/</a>
Machine learning	Technology enabling defect detection, quality control of product, print, pattern, also train to accept defects within a certain error range. After feeding it numerous good, bad, and acceptable patterns, it will be able to distinguish completely bad knit patterns from very slightly incorrect but still acceptable patterns.	Production	<a href="https://metait.cz/snizujem-e-chybovost-jersey/">https://metait.cz/snizujem-e-chybovost-jersey/</a>
Blockchain	The technology is a special type of distributed database storing an ever-expanding number of records that are protected against unauthorized intervention both from the outside and from the involved subjects themselves.	Traceability of product, digital passport of product	<a href="https://www.trick-project.eu/">https://www.trick-project.eu/</a>

	Possibilities for a tracking system of textiles are being explored,		
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## 2.3 Smart transition

Technology/innovation/Changes	Description	Processes impacted by the technology	Examples (links..)
Smart textiles	Textiles enabling the integration of electronic functions, now a current topic of autonomous charging of these systems - especially solar cells and their connection with flexible storage systems	Utility value of textile, product manufacture, recycling	<a href="https://www.applycon.cz/index.php/produkty/nositelna-elektronika/">https://www.applycon.cz/index.php/produkty/nositelna-elektronika/</a>
Recycling of mixed materials	Recapture of raw materials from non-reusable products (primarily from textile fibers, not from PET bottles)	Raw materials production, product manufacture, recycling	Worn Again <a href="https://wornagain.co.uk/">https://wornagain.co.uk/</a>  FIB FAB <a href="https://cordis.europa.eu/article/id/300714-renewable-durable-clothes-are-a-fibfab-fit-for-a-green-future">https://cordis.europa.eu/article/id/300714-renewable-durable-clothes-are-a-fibfab-fit-for-a-green-future</a>
Biobased fibers	Design of bio-based polyamides and polyesters from renewable feedstocks rather than crude oil, and manufacture greener and structurally improved fibers and films. We also intend to showcase the use of our bio-based ingredients in a wide array of mass-produced consumer products across multiple markets, such as construction, automotive, packaging, garments, carpets and textiles.	Raw materials	<a href="https://www.effective-project.eu/The-Project/">https://www.effective-project.eu/The-Project/</a>
Nanomaterials	Nanofibers with diameters in the nanometer range. Nanofibers can be generated from different polymers and therefore have different physical properties and application potential – health, environment, filtration, decontamination, industry, air cleaning, energy storage	Utility value of textile, product manufacture, recycling	<a href="https://www.contipro.cz/portfolio/4SPIN-zarizeni-pro-nanotechnologie?cpnb_method=cpnbCookiesDeclined">https://www.contipro.cz/portfolio/4SPIN-zarizeni-pro-nanotechnologie?cpnb_method=cpnbCookiesDeclined</a>

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

#### 3.1 Strategies, studies, tools

##### Strategy of the textile and clothing industry until 2025

[http://www.atok.cz/folders/Strategie\\_TOP\\_do\\_roku\\_2025.pdf](http://www.atok.cz/folders/Strategie_TOP_do_roku_2025.pdf)

The Association of the Textile and Clothing Industry is professional organization, a member of the European textile platform, has an established ATOK platform for the circular economy, is a member of the EURATEX confederation and involved in its working groups for the circular economy, traceability and for perfluoroalkyl chemical substances (PFAS). This strategy review development scenarios, recommending focus on development of advanced technologies and unique products and the active, consistent processing of European and non-European markets, emphasize social responsibility and long-term sustainability both in relation to the regions in which it operates and to the supply destinations. as problems defined mostly collectively. Focus on technical textiles, gradual transition to smart textiles, which creates the need for a higher proportion of R&D, higher added value of upgrading the skills of workers

##### Foresight of research trends in the Czech textile and clothing industry and regional innovation S3 activities

[https://ctpt.cz/img\\_webimg/img\\_editor/soubory/Foresight\\_vyzkumnych\\_trendu\\_CTPT.pdf](https://ctpt.cz/img_webimg/img_editor/soubory/Foresight_vyzkumnych_trendu_CTPT.pdf)

ČTPT – Česká technologická platforma pro textil (The Czech Technological Platform for Textiles)

Trends, their impacts, opportunity for companies and research were defined trends affecting the textile and clothing industry (TCI). Subsequently, relevant research topics were proposed for the cooperation of research and companies.

In the area of advanced materials and the area of green and digital technologies and processes, the focus is on:

**Green:** dematerialization, recyclability of raw materials, circular models, minimization of raw material consumption, waste processing, repeated use of water, materials, chemicals, reduction of energy intensity, climate protection – reduction of production of greenhouse gases and pollutants, biomaterials,

**Digital:** digital technology in prototyping, virtual modeling, digitization of production processes, e-commerce, integration of communication, monitoring and "smart" responsive elements into textile substrates; data processing, dematerialization, linking with the user sphere and professional maintenance; personalization

**Smart products:** e-textiles changing their utility properties based on external stimuli measured by surrounding sensors, wearable electronics, functional materials, composite structures, composite materials

##### Research and Innovation Strategy for Smart Specialization

<https://www.ris3.cz/en>

In terms of advanced textile materials, the focus is as follows: intelligent materials, nanomaterials, biomaterials, metal, composite, polymer, textile and other materials), New non-wovens and smart textiles, smart apparel with sensing functions, Advanced fiber-based materials including hybrid textile structures, multifunctional textile structures, structures capable of generating energy, structures with integration of sensors and other electronic ones elements, nanofibrous scaffolds for the growth of microorganisms and cells for broad-spectrum applications, new filter materials and technologies, biotechnology in relation to textile structures (e.g. substitution of chemical processes, creation of functional properties of textiles, use of enzymes, use of biopolymer and biomass, replacement of fossil materials, Photonics and micro/nanoelectronics in connection with textile structures and fibers (transmission of electrical impulses, integration of sensors, provision of data communication options), etc.

RIS3 also responds to social challenges, in the form of so-called missions. Advanced textile industry and advanced textile materials will find application especially within the mission "Efficiency of material, energy and emissions the demands of the economy". This mission is of critical importance for both green and digital transformation

##### Digital Czechia - Strategy of coordinated and comprehensive digitization of the Czech Republic 2018+

<https://www.digitalnicesko.cz/>

"Digital Czechia" is a set of concepts and implementation plans ensuring the prerequisites for the long-term prosperity of the Czech Republic in the environment of the ongoing digital transformation

Supporting the development of artificial intelligence in various sectors of the economy, high-performance computing, open data sources, new technologies and innovative business models

WP2. [Czech National Report]

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Promoting interoperability between sectors and the adoption of digital technologies across sectors of the company. One of the concrete impacts of this strategy is the creation of a **network of european digital innovation hubs in Czechia** - <https://digital-strategy.ec.europa.eu/en/activities/edihs>, which will help SMEs with digital transformation

#### Waste Management Plan 2015 – 2024

[https://www.mzp.cz/C1257458002F0DC7/cz/plan\\_odpadoveho\\_hospodarstvi\\_aj/\\$FILE/OODP-WMP\\_CZ\\_translation-20151008.pdf](https://www.mzp.cz/C1257458002F0DC7/cz/plan_odpadoveho_hospodarstvi_aj/$FILE/OODP-WMP_CZ_translation-20151008.pdf)

The plan focuses on the prioritization of waste management methods according to the waste management hierarchy and the fulfillment of European goals in all areas of waste management.

A detailed analysis of waste streams was carried out for **textiles**.

**Weaknesses** were identified insufficient

- separate concentration of textile waste
- consideration of long-term functionality, reparability or recyclability of products in their design and production
- information on substances of concern and their potential presence in recycled materials and products made from recycled materials
- level of innovation in all parts of the economic and life cycle of products
- Lack of respect for the hierarchy of waste management
- Prioritizing cheaper technologies for waste treatment at lower levels of the waste management hierarchy

**Opportunity** was identified as:

- Material ecodesign
- Increasing the intensity and quality of awareness and education in the area of the circular economy
- Innovation in the field of more efficient processing of raw materials, materials and waste
- Development of material recycling
- Development of thermal depolymerization technologies and subsequent physical-chemical recycling of waste
- Digitization in the monitoring of material flows
- Digitization in monitoring the content of substances in waste
- Development of capacities, projects and platforms for the reuse of things
- Green public procurement with an emphasis on the circular economy
- Support for environmental labeling and the EMAS environmental management and audit system

**Threats:**

- Increasing presence of microplastics from waste in the environment
- The presence of dangerous and suspicious substances in waste recycles

#### Project SS02030008 Center for Environmental Research: Analysis of textile waste flows in the Czech Republic

[https://www.cenia.cz/wp-content/uploads/2022/08/ZP-PZ\\_abstrakt\\_Shtukaturova\\_CJ.pdf](https://www.cenia.cz/wp-content/uploads/2022/08/ZP-PZ_abstrakt_Shtukaturova_CJ.pdf)

Two main streams were identified, namely industrial textile waste and textile waste from households. The results showed that in the production of industrial there was no significant increase in textile waste: in 2010, the amount of industrial textile waste was 70,405 tons and in 2019 87,840 tons. The opposite situation is with textile waste from households: in 2019, production was 37,393 tons and compared to 2010, it is almost ten times higher. In addition long-term analysis of mixed municipal waste (MSW) samples showed that the samples contained around 7% of different types of used textile products that could be suitable for recycling.

Surprisingly, according to the MFA, based on official data, mainly more complex textile waste is recycled from households, while more homogeneous industrial textile waste with a known composition is more common landfill or incinerate. Our results confirm that the **Czech Republic is not well prepared for compliance of the ambitious recycling targets** of the Action Plan in connection with textile waste for reasons constantly increasing volumes of this type of waste and hard-to-find official statistics on its production, the lack of recycling technologies and the obsolescence of the waste collection system

#### National network of European Digital Innovation Hubs

<https://digital-strategy.ec.europa.eu/en/activities/edihs>

The EDIH network was established in the Czech Republic - these are independent entities or coordinated groups of entities (consortia) with complementary expertise and a non-profit goal that support the digital transformation of WP2. [Czech National Report]

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D2.1. Gap analysis report including national and EU reports

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enterprises and public sector organizations at the regional level. They are supposed to provide services to entrepreneurs precisely in the field of digitization. These are technologies, training, testing, various prototype solutions. Furthermore, information on the market situation or various business models. The goal is for workplaces in individual European countries to become technology contact centers. They are supposed to provide digitization services to entrepreneurs in the given regions

### COVID 19 and its impact on business

[https://amsp.cz/wp-content/uploads/2021/03/lpsos-pro-AMSP\\_Covid-a-Zm%C4%9Bny-v-podnik%C3%A1n%C3%AD\\_FINAL-TZ.pdf](https://amsp.cz/wp-content/uploads/2021/03/lpsos-pro-AMSP_Covid-a-Zm%C4%9Bny-v-podnik%C3%A1n%C3%AD_FINAL-TZ.pdf)

The main goal of the research was to find out how business entities perceive changes in their business in the context of a pandemic situation. Questionnaire survey, 188 enterprises, collection took place 1 - 15 February 2021

2 out of 3 small and medium-sized enterprises have been negatively affected by the situation surrounding Covid-19. Most often due to a decrease in orders or the need to interrupt/reduce activities. 3 out of 10 companies had to tap into financial reserves due to the situation. Same ratio companies postponed investments due to the pandemic. A moderate majority (55%) of negatively affected businesses expected that the recovery from the crisis will be theirs will take more than a year. 24% subjects have significantly expanded their homeoffice, half of subjects feel increase pressure to digitalize, this applies primarily to companies, new technologies have helped many not to fall to the bottom. 3 out of 10 companies speed up the digitization process due to COVID-19. 2/3 of the subjects said that the crisis has not affected the digitalization process. The situation surrounding Covid-19 has clearly rapidly accelerated the use of communication platforms such as Zoom, Teams, Webex, Google Meet, etc. It has also accelerated the online version of certain services and products in the field of education and the consumer market. On the other hand, it is evident from the survey that companies have been working with digitization for a long time, and the pace of digitization, for example in production, is not directly dependent on unexpected external factors. Services, on the other hand, offer an explanation that they achieved a relatively high degree of digitization even before the covid era

## 3.2 Projects

<b>Name</b>	<b>EXTRATEX - European framework for cross-sectoral innovation in the fields of textiles-transport-sustainability and excellence for industrial clusters</b>
<b>Area</b>	<b>Green, advanced materials</b>
<b>Description</b>	The project brings together clusters from various strategic sectors of European industry with a high potential for cooperation. Namely, it concerns the fields of textiles, transport and sustainable materials, plastics, it also deals with connections with COVID.
<b>Link</b>	<a href="https://extratex.eu-vri.eu/">https://extratex.eu-vri.eu/</a>

<b>Name</b>	<b>RESET – Research Center of Excellence in Textile Industry</b>
<b>Area</b>	<b>Green</b>
<b>Description</b>	RESET addresses 6 key themes: Recycling in textile and waste disposal, Water consumption and energy saving, sustainable company organisations, New sustainable chemistry, including reduction of chemical substances, Smart textiles and new ways of production, Eco-creativity, natural fibres, short value chains, New materials and new application
<b>Link</b>	<a href="https://projects2014-2020.interregeurope.eu/reset/">https://projects2014-2020.interregeurope.eu/reset/</a>

<b>Name</b>	<b>ENTeR – Expert Network for Textile Recycling</b>
<b>Area</b>	<b>Green</b>
<b>Description</b>	ENTeR has developed a system capable of enhancing the value of industrial textile waste based on the characterization and classification of their properties and using an online platform (M3P) for the matching of “materials and waste”. Project realized <ul style="list-style-type: none"> <li>- 9 pilot cases</li> <li>- 5 training modules</li> <li>- Textile waste database</li> <li>- Strategic Agenda and Action Plan</li> </ul>

<b>Link</b>	<a href="https://www.interreg-central.eu/Content.Node/3.html">https://www.interreg-central.eu/Content.Node/3.html</a>
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<b>Name</b>	<b>DiGi Prime – Digital Manufacturing Platform for Connected Circular Smart Factories</b>
<b>Area</b>	<b>Digital</b>
<b>Description</b>	Project develops the concept of a circular economy digital platform in order to create circular business models based on the data-enhanced recovery and reuse of functions and materials. Project activities contains for instance the Product Avatar tool, which is a software solution that allows different actors to manage the information related to a real Product during its ongoing lifecycle. The actors that interact with the Product information can have different roles and can be working in different companies. Through the Product Avatar it is possible to search all the information already saved in the platform, related to a specific object.
<b>Link</b>	<a href="https://www.digiprime.eu/">https://www.digiprime.eu/</a>

<b>Name</b>	<b>TRICK – Empower Circular Economy with Blockchain Data Traceability</b>
<b>Area</b>	<b>Digital</b>
<b>Description</b>	Project supports the adoption, tracing and demonstration of <b>sustainable approaches</b> by means of an <b>innovative and circular product information management system</b> based on <b>Blockchain</b> and able to provide stakeholders of the supply chains and final consumers with all the relevant data needed to implement end of waste practices and aware purchasing choices.
<b>Link</b>	<a href="https://www.trick-project.eu/">https://www.trick-project.eu/</a>

<b>Name</b>	<b>Better Factory - Grow your manufacturing business’ — ‘Better Factory’</b>
<b>Area</b>	<b>Digital</b>
<b>Description</b>	In the frame of project is a RAMP (Robotics Automation Marketplace), free and open IoT (FIWARE) platform available, it is running on state-of-the-art servers with access to cloud storage and computing, enabling connection to robots, sensors, cameras, AR/VR and other equipment. RAMP will provide a 3D simulation tool to create a Digital Twin for virtual testing, a team building space for online collaboration between other digital services.
<b>Link</b>	<a href="https://betterfactory.eu/">https://betterfactory.eu/</a>

<b>Name</b>	<b>BETITEX - Development of sustainable textiles against bugs</b>
<b>Area</b>	<b>Smart</b>
<b>Description</b>	Project which aims to obtain textile materials protecting humans against ticks and bedbugs.
<b>Link</b>	<a href="http://www.betitex.eu/">http://www.betitex.eu/</a>

<b>Name</b>	<b>NANOFASE - Nanomaterial Fate and Speciation in the Environment</b>
<b>Area</b>	<b>Smart</b>
<b>Description</b>	Project is aimed at prediction of environmental distribution, concentration and form (speciation) of nanomaterials, to allow early assessment of potential environmental and human exposure and risks, to facilitate safe product design and to include these aspects in nano regulation.
<b>Link</b>	<a href="http://www.nanofase.eu/">http://www.nanofase.eu/</a>

<b>Name</b>	<b>BleNaBis - Blends of Natural and Biosynthetic fibres for eco-efficient yarns</b>
<b>Area</b>	<b>Smart</b>
<b>Description</b>	BleNaBis deals with research into the possibilities of applying renewable fiber sources - fibers from oilseed stalks (waste from the production of a nutritional source), bio-polyamide and their mixtures for the production of yarns intended for interior textiles. The aim is to ensure the usability of renewable fibrous biodegradable materials as a replacement for synthetics from fossil sources and thereby reduce environmental burdens.
<b>Link</b>	<a href="https://starfos.tacr.cz/cs/project/EG15_007_0001812">https://starfos.tacr.cz/cs/project/EG15_007_0001812</a>

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

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

Industry field research was the main source for finding innovations relevant to green, digital and smart processes. Representatives of the companies identified the main strengths and weaknesses, challenges and threats, and a SWOT analysis was created during the session.

The area of green transformation was seen as key sphere. The companies have declared their interest in production with a low impact on the environment, but at the same time they name the legislation related to the Green Deal and the Strategy for the sustainable textile industry as a key part of their further activity. They named as the main focus areas following:

- **Legislative** – new requirements appear, small sub-divisions do not have the capacity to monitor everything and apply it professionally
  - Knowledge about the **lifespan of materials** - they are interested in a course that would focus on information on how to assess the lifespan of materials, how to increase it, and what decreases it
  - **Biodegradability and compostability** – use of the properties of textiles only for a specified period of time, prerequisites for the degradability of materials without negative impact on the environment
  - **Recyclability** – information about what properties a textile product must have (material composition, design,...) in order to be recycled, knowledge about recycling technologies
  - **Energy intensity** of production – practical examples and instructions for production design and consideration of ecodesign requirements according to the relevant guidelines, economic aspects and analysis
  - The **investment requirement** of green technologies
  - Setting up a comprehensive **system and technology of collecting and using textiles**, this is a completely new element
  - **Composition information flows** - importance of storing information on the composition of materials - it would allow easier recyclability
- What does innovation relevant to smart mean for companies and where is innovation in the processes

As part of the discussion on the development of advanced textiles, **multidisciplinarity** and the ability to work together in teams of specialized experts with a wide range of knowledge were emphasized. Advanced textiles with specific properties need advanced knowledge for their design and production - **electrical engineering, physics, mathematics, chemistry, biology, IT**. Smart textiles were most often associated with **wearable electronic elements, nanotechnologies and biomaterials**. The need to constantly expand one's knowledge of materials - especially **materials from recycled raw materials**, the ability to evaluate the **properties of recycled fibers**, to solve the specific needs of the **production of recycled fibers** and related phenomena - such as the release of **microfibers and microplastics**, recycling of mixed materials, was emphasized.

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

Digitization is perceived as an area with high potential, but the biggest gap in knowledge is perceived here. The following areas were mentioned most often:

- **Data** collection and sorting, methods of evaluation
- **Visualization** tools for product design and production modelling
- **Online platforms, websites, configurators** - all this for communication with the customer, presentation
- **IoT** – knowledge for remote connection of text components to the Internet, control, matching of functions
- **AI – machine learning** – production quality monitoring, sample evaluation
- **Digital passport** of the product and technologies that allow the desired information to be stored and displayed
- **Blockchain** – use within production chains monitoring material flows is being pilot tested within the project,

- **Cybersecurity** – this area is important, companies see this as a barrier to wider use of digital platforms, cloud, distributed databases.

## 4.1 Green

Functional areas of the company	Technology/innovation/Changes	Knowledge needed to perform the process	Priority Training Topics to be addressed
Strategy of the company	Green transition, EU strategy, Legislation Non-financial reporting types of circular business models	Knowledge of new trends - foresights, Environmental regulations and policies Energy intensity of operations Dematerialization Energy-efficient technologies in industry. Factory structure. Maintenance of new technologies. Monitoring software. Planning and organization to create efficient productive energy.	Principles of sustainability Linear vs. circular business model Waste as raw material Recycling. LCA studies, carbon footprint and environmental declaration. Eco-efficiency in the value chain. Sustainable functionalization by process. Green contracts Separated textile collection systems environmental labeling and the EMAS environmental management and audit system
Design of production	Ecodesign Life Cycle Assessment (LCA) (and other Life Cycle analysis) Ecodesign	LCA methodology Energy and material consumption material properties of fibers textile technology knowledge about chemicals, especially PFAS chemicals Sustainable transport and logistic systems	LCA for different types of materials – natural and chemical Carbon footprint Sustainable transport and logistic systems Knowledge of PFAS substances
Production	Ecodesign in the area of energy in the area of energy intensity of production Water reduced processes Energy reduced processes PFAS chemicals, microplastics	Regulations in the field of ecodesign Material properties of recycled fibers Textile technologies Recycling technology Work with chemicals Prerequisites for increasing lifetime and controlled fiber release	Regulations in the field of ecodesign Material properties of recycled fibers Recycling technology Work with chemicals Prerequisites for increasing lifetime and controlled fiber release
Sales, communication	Non-financial reporting, Social Responsibility	regulations and policies of non-financial reporting	Changes and new environmental regulations and policies Greenwashing
Customer service	personalized products and services, product according to the customer's design	Smart materials, Woven and nonwoven textiles, electronics, sensors	Methodology - Product as a service
Waste management	Collecting and recycling technology	Vlastnosti materiálů – předpoklady pro zajištění recyklovatelnost	AI and Blockchain. Data management

## 4.2 Digital

Functional areas of the company	Technology/innovation/Changes	Knowledge needed to perform the process	Priority Training Topics to be addressed
Strategy of the company	Digital collaboration platforms	IT architecture	Types of applications, HW, SW for textile industry, ERP systems
Design of production	Virtual design of garments Development of platforms for waste as a material Digitization in the monitoring of material flows Digitization in monitoring the content of substances in waste Development of capacities, projects and platforms for the reuse of things	Application for design of materials and products	Database systems, Data collection and sorting, methods of evaluation Visualization tools for product design and production modelling Cybersecurity – this area is important, companies see this as a barrier to wider use of digital platforms, cloud, distributed databases
Production	Machine learning - product quality control	Artificial intelligence	AI – machine learning – production quality monitoring, sample evaluation
Sales, communication	Blockchain – a decentralized database for tracking material and product flows	Online platforms, configurators	Online platforms, websites, configurators - all this for communication with the customer, presentation
Customer service	Configurators, AI for modification of the product according to the customer's needs	IoT	IoT – knowledge for remote connection of text components to the Internet, control, matching of functions
Waste management	Development of capacities, projects and <u>platforms for the reuse of things</u>	blockchain	Digital passport of the product and technologies that allow the desired information to be stored and displayed Blockchain – use within production chains monitoring material flows is being pilot tested within the project,

## 4.3 Smart

Functional areas of the company	Technology/innovation/Changes	Knowledge needed to perform the process	Priority Training Topics to be addressed
Strategy of the company	Smart textiles	Smart materials, Woven and nonwoven textiles, electronics, sensors	Electronics, physics, polymers, chemicals,

Design of production	Recycling of mixed materials presence of microplastics from waste in the environment	Knowledge of the properties of special trains, recycled	Electronics, physics, polymers, chemicals
Production	Biobased fibers Nanomaterials	Smart materials, Woven and nonwoven textiles, electronics, sensors	Electronics, physics, polymers, chemicals
Sales, communication			
Customer service			
Waste management	thermal depolymerization technologies and subsequent physical-chemical recycling of waste		Electronics, physics, polymers, chemicals

## 5. Initial and further education on advanced textiles

The focus in the area of initial education on secondary education and higher education is given In the annex – “List of the current textile VET education programmes and courses”, as well as description of the educational courses for the textile industry, in the area of professional education – face-to-face and online education. These courses are mostly the product of projects supported by the EU or private initiatives.

Initial secondary education in the Czech Republic is divided into the education programme “Textiles” and educational programme of “Clothing”. Textiles is a technologically oriented programme. This programme is offered by only one school, namely the Secondary Technical School of Textiles in Liberec (<https://www.texlib.cz/>), educational programme “Clothing” with a higher representation of design subjects is offered at several schools in the Czech Republic, it is rather artistic and craft oriented.

High Education Institution in the textile industry is only one faculty in the Czech Republic, namely the Faculty of Textiles of the Technical University in Liberec (<https://www.ft.tul.cz/en/>). A detailed description of the education system, orientation, educational offer, focus of research and implemented projects is part of annex, as well as a special material that was processed in the form of a subcontract.

VET professionals in the textile field are offered by several organizations: TZÚ - Textile Testing Institute (<https://www.tzu.cz/vzdelavani>), ATOK - Association of Textile and Clothing Industry (<http://www.atok.cz/141-projekty.html>), INOTEX – a company focusing on research, development, service and technology transfer in the field of textile refinement and new technologies (<http://www.inotex.cz/e-learning.aspx>), ČTPT – Czech Technological Platform for Textiles, INCIEN – a non-profit organization focusing on the promotion of the circular economy (<https://incien.org/publikace/>, <https://incien.org/circularnizadavani/>), last but not least also the company matériO – a library of materials (<https://www.materioprague.cz/towards-sustainability/>).

The main needs in relation to education were identified as:

The slow transformation of study programs to new emerging technologies and materials, to new requirements in conjunction with the implementation of the circular economy trend and Green Deal goals, was confirmed. Available courses offering some sub-topics, not a complete, interconnected system. There is a larger offer at the VET professional level (mainly thanks to the implementation of EU projects, at the HEI level the offer of online courses is only limited, not corresponding to the twin transition topics, at the secondary school level VET initial online courses are only prepared as support materials for teachers and pupils. The necessity of preparation for multidisciplinary solutions, changes to the "curriculum" in textile education at all levels, incorporation of new competences into the competence requirements for job positions at different levels of the textile value chain. New information and knowledge must be provided to workers in companies together with familiarization with new technologies, at the same time maintaining pressure to focus research and development in selected directions.

The lack of middle management personnel for textile operations, the emphasis on accessible lifelong learning, was confirmed. In this context, the online education system is still insufficiently developed, there is an insufficient portfolio of courses available to a wide group of people interested in education for the needs of the twin transition textile industry. A specific area is IT, also in connection with the concept of Industry 4.0, the use of advanced IT technologies (machine learning, working with data, their evaluation, IoT, preparation of flexible operations and business models according to customer needs, aspects of greater responsibility of the manufacturer for the entire value chain of the product, including the use of recycling in the form of a new product or raw material. The importance of professional training in cooperation with practice was confirmed.

With regard to higher education, the need to position the basic concept of teaching consistently on the model of circularity and explanation of contexts (emphasis on multidisciplinary (for example, for students of mechanical faculties, it is necessary to ensure sufficient knowledge of the specific properties of textile materials - necessary for the correct targeting of machine construction) is perceived also insufficient focus on recycling technologies, emphasis on the overall concept of circularity from product design to waste management Continuous training of employees in the field of new types of fibers or fibers with new properties that may require a specific approach when using them.

The evidently growing importance of the specific functionalization of fibers and surface textiles requires preparation for multidisciplinary solutions, communication and correct interpretation of customer requirements and analysis of market trends. Speed of reaction in directing production; respect technologically possible (and environmentally friendly) solutions during design. Direct the teaching to new emerging fibers, including biofibres.

In the field of advanced materials, the growing importance of specific functionalization of fibers and flat textiles is evident, requiring preparation for multidisciplinary solutions, communication and correct interpretation of customer requirements and analysis of market trends. Speed of reaction in directing production; respect technologically possible (and environmentally friendly) solutions during design. Direct teaching to new emerging threads incl. biofibres, use of natural fibers produced in EU countries.

The national system of qualifications specifies 54 professional qualifications for the textile sector, the 2 highest qualifications are at level 6. The following professions will most likely be most affected by the twin transition:

1. Independent clothing technician technologist / independent clothing technician technologist
2. Independent textile technician/technologist/independent textile technician technologist
3. Textile designer
4. Textile Technician
5. Textile technology
6. Textile Technician/Quality Controller
7. Business ecologist
8. Environmental protection management system consultant

## 5.1 Strategies, documents, tools

### **Education policy strategy of the Czech Republic until 2030+**

<https://www.msmt.cz/vzdelavani/skolstvi-v-cr/strategie-2030>

A key document for the development of the educational system of the Czech Republic in the decade 2020 – 2030+. The aim is to modernize the Czech education system in the field of regional education, interest-based and informal education and lifelong learning, prepare it for new challenges and at the same time solve problems that persist in Czech education

### **The National System of Occupations**

<https://www.nsp.cz/odborny-smer/textilni-a-odevni-vyroba>

The National System of Occupations is an open and publicly available internet database of information on occupations that occur on the Czech labor market. It is created by employers through sector councils as their representative representatives, and the state is the guarantor.

The given link is directed to the occupations listed in the textile and clothing industry.

### **The Central Database of Competences**

WP2. [Czech National Report]

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D2.1. Gap analysis report including national and EU reports

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<http://kompetence.nsp.cz/>

Competences represent a sum of knowledge, skills, abilities, attitudes and values enabling the application and personal development of an individual. It is the language in which the requirements for a worker are described in the National Occupational System. They express prerequisites for the performance of a certain set of activities. They say what the employee should know, be able to do and how to behave.

### The National System of Qualifications

<https://www.narodnikvalifikace.cz/>

The portal is an information base on the system of nationally recognized professional qualifications in the Czech Republic. This tool publishes information about professional qualifications as of today approved and applicable on the labor market in the Czech Republic. This website informs about everyone news and events in the field of verification and recognition of the results of another education in the Czech Republic.

### Project Competence 4.0

[https://www.mpsv.cz/documents/20142/372813/2W\\_Kompeten%C4%8Dn%C3%AD+pyramidy+a+New+Skills+Monitor.pdf/fe6d92b-ef1b-da10-70e3-dd52de104405](https://www.mpsv.cz/documents/20142/372813/2W_Kompeten%C4%8Dn%C3%AD+pyramidy+a+New+Skills+Monitor.pdf/fe6d92b-ef1b-da10-70e3-dd52de104405)

1. Analysis of methods of mapping future competencies using foreign ones experience, determination of priority sectors with the impact of Industry 4.0 on the marketwork and elaboration of the methodology for mapping future labor market competencies
2. Networking of experts – establishment and operation of sectoral working groups, training for the professional public
3. Expansion of the Central Competence Database (CDK) with future competencies in selected industries (textile industry is not a focus, but some competences are relevant)
4. Creation of sectoral competence pyramids in individual sectors with linked to the field of education
5. Support of dialogue between employers and educators at the regional/local level
6. Enforcing conditions for the implementation of outputs

## 5.2 Projects

<b>Name</b>	<b>EDTEX</b>
<b>Area</b>	<b>VET general</b>
<b>Description</b>	Comparative studies Comparison of the level of vocational education in selected countries - Using the strengths of school programs - To facilitate the integration and employability of young people who are interested in studying T+C industry fields - Support for cooperation between the educational and employer spheres the output is not e-learning, cooperation
<b>Link</b>	<a href="https://erasmus-plus.ec.europa.eu/projects/search/details/2016-1-CZ01-KA202-023832">https://erasmus-plus.ec.europa.eu/projects/search/details/2016-1-CZ01-KA202-023832</a>

<b>Name</b>	<b>SKILLS4SMARTEX</b>
<b>Area</b>	<b>Digital</b>
<b>Description</b>	Multidisciplinary for smart textiles - MOOC to use mathematics, physics, materials science and electrical engineering for smart textiles in the areas: <ul style="list-style-type: none"> <li>• novel fibers and yarns</li> <li>• material and methods</li> <li>• smart textile design</li> <li>• smart textile prototyping manufacturing</li> <li>• data processing</li> <li>• testing of smart textiles</li> </ul>
<b>Link</b>	<a href="https://erasmus-plus.ec.europa.eu/projects/search/details/2018-1-RO01-KA202-049110">https://erasmus-plus.ec.europa.eu/projects/search/details/2018-1-RO01-KA202-049110</a>

<b>Name</b>	<b>OPTIMTEX</b>
<b>Area</b>	<b>Digital</b>
<b>Description</b>	<p>1. Course of textile software applications with 5 modules:            Design software for weaving            Design software for knitting            Design software for virtual prototyping of clothing            Design software for embroidery            Design software for experimental design of e-textiles;</p> <p>2. A Guide for tech-transfer and for applying software solutions within textile enterprises;            3. A free web e-learning instrument for quick access to the project's educational materials;            4. The project's website with digital &amp; multimedia content on tech-transfer - <a href="http://www.optimtex.eu">www.optimtex.eu</a>            5. A Moodle e-learning platform with implemented courses in national languages - <a href="http://www.advan2tex.eu/portal/">www.advan2tex.eu/portal/</a></p>
<b>Link</b>	<a href="http://www.optimtex.eu">www.optimtex.eu</a>

<b>Name</b>	<b>MODISTO</b>
<b>Area</b>	<b>Green</b>
<b>Description</b>	<ul style="list-style-type: none"> <li>- To develop a course in e-learning modality to be used as support for VET teachers, whose contents will be related to eco-design and sustainability, and its use intended for the clothing and fashion sector.</li> <li>- To promote and disseminate the e-learning course within VET centers in the four participating countries.</li> <li>- To make the resources of the e-learning course openly available and promoted at international level as an open educational resource               <ul style="list-style-type: none"> <li>- Principles of ecodesign.</li> <li>- Sustainable materials.</li> <li>- Eco-labeling and certification</li> <li>- Sustainability criteria in the fashion and clothing sector</li> </ul> </li> </ul>
<b>Link</b>	<a href="https://proyecto-modisto.eu/cs">https://proyecto-modisto.eu/cs</a>

<b>Name</b>	<b>ECOMODA</b>
<b>Area</b>	<b>Green</b>
<b>Description</b>	environmentally friendly materials in textile and fashion sector training and educational opportunities and pathways EU experience opportunities and job career development in fashion best practices in textile and fashion sector enterprises ethical fashion; The Training Course will comprise four modules focusing on different aspects of fashion in partner countries such as policies and practices, useful information on sociocultural changes, new frameworks regarding fashion trends, etc.
<b>Link</b>	<a href="https://ecomoda-programme.eu/">https://ecomoda-programme.eu/</a>

<b>Name</b>	<b>TWIN Revolution – ongoing project</b>
<b>Area</b>	<b>Green</b>
<b>Description</b>	The aim of the project is to develop an innovative and interactive tool and training course that will strengthen and requalify vocational education and training students and provide them with the necessary digital and "green" skills and competences.
<b>Link</b>	<a href="https://twinrevolution.eu/">https://twinrevolution.eu/</a>

## 6. Conclusions

This national report summarizes the Czech situation of textile education and industry, how the green, smart and digital transition are being carried out, and the future challenges.

Desk research as well as field research showed that topics associated with green and digital transformation are not processed in the form of a comprehensive program. Greater urgency is perceived in the area of smart and green transition, the survey fully confirmed the priorities of the strategy for a sustainable textile industry. The use of digital transition technologies is still limited, but there is great interest in the development of knowledge about these technologies.

Professional organizations provide VET education. Despite the indisputable impact of COVID on the development of online educational platforms, we note that the offer of online education does not have the character of MOOC educational modules in green and digital transformation, rather partial webinars are available. However, the focus on green topics in secondary school curricula does not fully meet the new requirements of companies, but schools are open to modifying school educational programs. For example, environmental issues are focused only on understanding the framework context, new concepts, such as ecodesign, are still missing and are being addressed on a pilot basis within a sub-project focused on the clothing industry.

Educational programs at universities correspond to the needs of companies to a better extent, but online education is very limited, currently it is only offered in partial areas of textile technology. From this point of view, there is still a significant lack of availability of knowledge for textile companies and other people interested in knowledge in the textile industry.

Companies welcome the initiative of open educational platforms and other forms of education of experts. Companies implement forms of Worked Based Learning in the form of excursions, internships for pupils and students at companies, participation of company employees in lessons (tandem teaching), processing of student works on a topic given by the company, etc. Schools have school workshops available, pupils have the opportunity to set up so-called fictional company (can also be a real company - especially for HEI students)

Businesses are interested in developing digital skills. There is a reasonable assumption that the spread of digital technologies would increase interest in the film industry among young talents.

The survey clearly showed that there is an increasing need for science knowledge - physics, chemistry, biology, polymers, as well as a digital focus.

Annex: List of the current textile VET education EU programmes and courses (initial and professional education)

Country	Title of resource	Type of resource	Level	Education level	Area	Curricula title	Main topics	Education Level	Websites	Contact (where relevant)
Czechia	Secondary Technical School of Textiles in Liberec	School educational programme	National	Secondary school	Green	Basics of biology and ecology	<ul style="list-style-type: none"> <li>Basic signs and conditions of life</li> <li>- properties of living systems</li> <li>- cell types</li> <li>- diversity of organisms and their characteristics</li> <li>- human biology</li> <li>- health and illness</li> <li>- factors influencing health</li> <li>- risky behavior</li> <li>Basics of general ecology</li> <li>- basic ecological terms</li> <li>- environmental factors</li> <li>- food chains</li> <li>- cycle of substances in nature and flow of energy, types of landscapes</li> <li>Human being and the environment</li> <li>- mutual relations between man and the environment</li> <li>- the effects of human activities on the environment</li> <li>- natural and replaceable sources of energy and raw materials</li> <li>- wastes</li> <li>- global environmental problems</li> <li>- the company's environmental protection tools</li> <li>- principles of sustainable development</li> <li>- individual responsibility for the protection of nature and the environment</li> </ul>	VET initial	<a href="https://www.texlib.cz/">https://www.texlib.cz/</a>	<a href="mailto:koci.jana@texlib.cz">koci.jana@texlib.cz</a>
Czechia	Secondary Technical School of Textiles in Liberec	School educational programme	National	Secondary school	Digital	Computer design	<ul style="list-style-type: none"> <li>Work with graphic software</li> <li>3D printing</li> <li>- 3D modeling tools, press strings, photopolymers, color FFF printing, Slicer settings, 3D scanning, photogrammetry,</li> <li>- working with 3D modeling tools</li> <li>Practical work</li> <li>- creation of textile printing</li> <li>- preparation of textile print for printing</li> <li>- preparation of computer design for product presentation and support</li> <li>- computer design printing for product presentation and support</li> <li>- preparation of documents for large-scale digital printing</li> <li>- creation of a model in 3D</li> </ul>	VET initial – not online	<a href="https://www.texlib.cz/">https://www.texlib.cz/</a>	<a href="mailto:koci.jana@texlib.cz">koci.jana@texlib.cz</a>

							- preparation for printing the 3D model - printing of 3D models and postprocessing			
Czechia	Faculty of Textile Engineering, Technical university of Liberec (FT TUL)	School educational programme	National	university	smart	Materials engineering	- highly functional textile - special fibers - textile nanomaterials - special technology - Physical principles of nanofiber formation - Nanofiber production technology - Automotive and technical clothing - Evaluation of the comfort of textiles	HEI initial – not online	<a href="https://www.ft.tul.cz/en/">https://www.ft.tul.cz/en/</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	Faculty of Textile Engineering, Technical university of Liberec (FT TUL)	School educational programme	National	university	green		- processing of secondary raw materials, technological procedures of recycling (downcycling, upcycling) - technical preparation of production and logistics - clothing business management - strategic planning, process analysis, technical-technological production preparation, trademarks, branding, counterfeiting of stamps - Breeding - a lecture on the topic of Current Breeding Trends (biotechnology, sustainability issues...) - Strategy for the sale of textile goods - lectures on the topic Qualitative and ecological aspects of the saleability of a textile product and the importance of ISO-norms, ECO-certificates and trademarks on the textile market. - Textile goods knowledge 1 - lecture on BIO versus ECO textile raw material - acquisition, processing and marking in products - Fiber engineering - lecture on Ecology and recycling of fibers: Ecology, toxicity of fibers, recycling of fiber materials, lifetime and aging of fibers - Quality assurance systems – lecture on Quality and ecology, environmental management system - Ecological aspects of production and use of composites. - Textile chemistry - a whole range of topics: bleaching (ecological aspects and AOX), carcinogenicity of dyes, expressing the toxicity of	HEI initial – not online	<a href="https://www.ft.tul.cz/en/">https://www.ft.tul.cz/en/</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>



							dyes, ecological problems during processing, examples of recycling procedures.			
Czechia	Faculty of Textile Engineering, Technical university of Liberec (FT TUL)	School educational programme	National	university	digital		<ul style="list-style-type: none"> <li>- CAD/CAM systems in clothing production, use of PIS systems (enterprise information systems) and engineering methods to support the management and planning of business processes, principles of CAx systems (computer support) within the pre-production and production stages, CAx applications used in clothing production, including hardware support and using automatic identification (bar codes, radio frequency detection) to support data collection.</li> <li>- Smart clothing - development of Smart textiles and their application, materials used for the production of Smart clothing, wearable electronics and classic sensors, textile sensors and applications in clothing and protective clothing.</li> <li>- Basics of programming in MatLab - sample examples and specific tasks from industrial engineering</li> <li>- Processing, analysis and evaluation of digital image data</li> <li>- Computer-aided modeling - methods for effective work with large-volume data from modern CT scanners and their geometric presentation, geometric design of longitudinal and surface textile structures, analysis of basic mechanical properties on a virtual model using the finite element method</li> <li>- Automation in the clothing industry - types of drives, their properties. Pneumatic circuits, examples of their solutions and applications in clothing production. Automated sewing machines. Conveyor systems. Application of robots for handling in the clothing and textile industry, assembly operations.</li> <li>- Computer-aided design - advanced 3D systems for designing clothes. Using the MTM method (Made To Measure) for the production of individual clothes. Modification and adjustment of the cut of</li> </ul>	HEI initial – not online	<a href="https://www.ft.tul.cz/en/">https://www.ft.tul.cz/en/</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>



							<p>ready-to-wear clothing. Correct identification of character types and shape changes, appropriate modification of cut. Use of CAD technology for customer modifications. Principles of shared data related to individual clothing production. DesignConcept 3D - software for developing templates from 3D objects. Creation of 2D templates from 3D design for prototyping. The principle of scanning the surface of the human body. Use of the CAD system CATIA and AutoCAD for applications in clothing and automotive manufacturing.</p> <ul style="list-style-type: none"> <li>- Computer simulation of clothing production – application of pseudorandom numbers for the definition of stochastic phenomena in simulation modeling, with evolutionary optimization algorithms (hill climb, simulated annealing, etc.). trends in computer-aided design, ergonomic simulations and the use of FEM methods for the simulation of partial problems occurring within ready-made production.</li> <li>- Special technology and measurements in clothing production - tensometric sensors, Temperature measurement, temperature fields. Application of thermographic methods. Methods of evaluating the comfort of textiles. Evaluation of measurements using the modern computer image analysis method NIS-Elements. Diagnostic methods for determining the structure and properties of textiles.</li> <li>- Fundamentals of electron microscopy. Unconventional separation methods (microwave, water jet, laser separation, plasma separation) and joining of textiles. Technique of the dividing and joining process of technical textiles. Basic principles of image reconstruction in CT systems, Micro-CT.</li> <li>- Construction and patterning of tensile knitted fabrics</li> </ul>		
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Czechia	FT TUL	Initial, VET professional	EU	university	technology	Project ROLIZ	structure and properties of textiles	HEI initial – online	<a href="https://elearning.tul.cz/course/view.php?id=5250">https://elearning.tul.cz/course/view.php?id=5250</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	FT TUL	Initial, VET professional	EU	university	technology	Project ROLIZ	clothing production technology	HEI initial – online	<a href="https://elearning.tul.cz/course/view.php?id=5101">https://elearning.tul.cz/course/view.php?id=5101</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	FT TUL	Initial, VET professional	EU	university	technology	Project ROLIZ	technical preparation of the production	HEI initial – online	<a href="https://elearning.tul.cz/course/view.php?id=5102">https://elearning.tul.cz/course/view.php?id=5102</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	FT TUL	Initial, VET professional	EU	university	technology	Project ROLIZ	theory of non-woven fabrics	HEI initial – online	<a href="https://elearning.tul.cz/course/view.php?id=4934">https://elearning.tul.cz/course/view.php?id=4934</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	FT TUL	Initial, VET professional	EU	university	technology	Project ROLIZ	textile goods knowledge	HEI initial – online	<a href="https://elearning.tul.cz/course/view.php?id=5255">https://elearning.tul.cz/course/view.php?id=5255</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	FT TUL	Initial, VET professional	EU	university	technology	Project ROLIZ	weaving and patterning of knitwear	HEI initial – online	<a href="https://elearning.tul.cz/course/view.php?id=5249">https://elearning.tul.cz/course/view.php?id=5249</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	FT TUL	Initial, VET professional	EU	university	technology	Project ROLIZ	weaving and patterning of fabric	HEI initial – online	<a href="https://elearning.tul.cz/course/view.php?id=5310">https://elearning.tul.cz/course/view.php?id=5310</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	FT TUL	Initial, VET professional	EU	university	technology	Project ROLIZ	basics of designing	HEI initial – online	<a href="https://elearning.tul.cz/course/view.php?id=5310">https://elearning.tul.cz/course/view.php?id=5310</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	FT TUL	Initial, VET professional	EU	university	technology	Project ROLIZ	refinement	HEI initial – online	<a href="https://elearning.tul.cz/course/view.php?id=5117">https://elearning.tul.cz/course/view.php?id=5117</a>	<a href="mailto:Jana.drasarova@tul.cz">Jana.drasarova@tul.cz</a>
Czechia	TZÚ	VET professional	EU	professional	technology	e-Ltex	A guide to trading textiles and clothing <ul style="list-style-type: none"> <li>• History of textiles</li> <li>• Business skills</li> <li>• Textile terminology – product knowledge</li> <li>• Technical regulations</li> <li>• Popularization of technical standardization</li> <li>• Basics of textile technologies</li> </ul>	VET professional	<a href="http://www.skolatextilu.cz/">http://www.skolatextilu.cz/</a>	<a href="mailto:dufkova@tzu.cz">dufkova@tzu.cz</a>





							<ul style="list-style-type: none"> <li>• Economic terms</li> <li>• ABC of textiles</li> </ul>			
Czechia	TZÚ	VET professional	EU	professional	technology	CETOK - Center for professional education	Face-to-face seminars - 10 new educational modules for 6 educational programs that correspond to the selected professional qualifications Spinner, Weaver, Knitter, Dresser, Manufacturer of non-woven textiles and Manufacturer of clothing, which were selected based on the needs of employers in accordance with the work plan of the Sector Council for Textile, Clothing and leather industry.	VET professional	<a href="https://www.tzu.cz/vzdelavani">https://www.tzu.cz/vzdelavani</a>	<a href="mailto:dufkova@tzu.cz">dufkova@tzu.cz</a>
Czechia	TZÚ	VET professional	EU	professional	smart	Advan2Text - e-learning course in advanced textile technologies	Advanced knitting technologies Virtual clothing design, 3D scanning, clothing for people with special needs New testing methods Standardization in textile testing Sustainability of textile technologies Business Innovation management	VET professional	<a href="http://www.advan2tex.eu/portal/?lang=cs">http://www.advan2tex.eu/portal/?lang=cs</a>	<a href="mailto:dufkova@tzu.cz">dufkova@tzu.cz</a>
Czechia	TZÚ	VET professional	EU	VET initial	green	MODISTO	kurz pro učitele Principles of ecodesign. Sustainable materials. Eco-labeling and certification Sustainability criteria in the fashion and clothing sector	VET professional	<a href="https://proyecto-modisto.eu/">https://proyecto-modisto.eu/</a>	<a href="mailto:dufkova@tzu.cz">dufkova@tzu.cz</a>
Czechia	TZÚ	VET professional	EU	professional	smart	Skill4Smartex	MOOC to use mathematics, physics, materials science and electrical engineering for smart textiles in the areas: <ul style="list-style-type: none"> <li>• novel fibers and yarns</li> <li>• material and methods</li> <li>• smart textile design</li> <li>• smart textile prototyping manufacturing</li> <li>• data processing</li> <li>• testing of smart textiles</li> </ul>	VET professional	<a href="https://erasmus-plus.ec.europa.eu/projects/search/details/2018-1-RO01-KA202-049110">https://erasmus-plus.ec.europa.eu/projects/search/details/2018-1-RO01-KA202-049110</a>	<a href="mailto:dufkova@tzu.cz">dufkova@tzu.cz</a>
Czechia	TZÚ	VET professional	EU	professional	Green, digital	TWIN Revolution (ongoing project)	Ongoing project an innovative and interactive tool and training course that will empower and retrain VET students and provide them with the necessary digital and "green" skills and competencies.	VET professional	<a href="https://twinrevolution.eu/">https://twinrevolution.eu/</a>	<a href="mailto:dufkova@tzu.cz">dufkova@tzu.cz</a>



Czechia	Faculty of Electrical Engineering University of West Bohemia	VET professional	EU	professional	Digital	OPTIMTEX	1. Course of textile software applications with 5 modules: <ul style="list-style-type: none"> <li>• Design software for weaving</li> <li>• Design software for knitting</li> <li>• Design software for virtual prototyping of clothing</li> <li>• Design software for embroidery</li> <li>• Design software for experimental design of e-textiles;</li> </ul> 2. A Guide for tech-transfer and for applying software solutions within textile enterprises; 3. A free web e-learning instrument for quick access to the project's educational materials; 4. The project's website with digital & multimedia content on tech-transfer ( <a href="http://www.optimtex.eu">www.optimtex.eu</a> ); 5. A Moodle e-learning platform with implemented courses in national languages ( <a href="http://www.advan2tex.eu/portal/">www.advan2tex.eu/portal/</a> );	HEI	<a href="http://www.optimtex.eu/">http://www.optimtex.eu/</a> ; <a href="http://www.advan2tex.eu/portal/">www.advan2tex.eu/portal/</a>	<a href="mailto:dufkova@tzu.cz">dufkova@tzu.cz</a>
Czechia	CLUTEX	VET initial	EU	secondary	green	Ecomoda	environmentally friendly materials in textile and fashion sector training and educational opportunities and pathways EU experience opportunities and job career development in fashion best practices in textile and fashion sector enterprises ethical fashion; The Training Course will comprise four modules focusing on different aspects of fashion in partner countries such as policies and practices, useful information on sociocultural changes, new frameworks regarding fashion trends, etc.	VET	<a href="https://ecomoda-programme.eu/results/result-1/">https://ecomoda-programme.eu/results/result-1/</a>	<a href="mailto:dufkova@tzu.cz">dufkova@tzu.cz</a>
Czechia	INOTEX, ČTPT	VET professional	Interreg Danube	professional	green	ENTER	Oběhové hospodářství v textilním průmyslu	VET	<a href="http://www.inotex.cz/e-learning.aspx">http://www.inotex.cz/e-learning.aspx</a> <a href="https://www.youtube.com/watch?v=oQFglxkWurc">https://www.youtube.com/watch?v=oQFglxkWurc</a>	<a href="mailto:beran@ctpt.cz">beran@ctpt.cz</a>
Czechia	INCIEN	VET professional	privat	professional	green	Circular procurement	Cirkulární ekonomika v teorii a praxi Cirkulární textil Crkularita jako služba	VET	<a href="https://incien.org/cirkularnizadavani/">https://incien.org/cirkularnizadavani/</a>	<a href="http://www.incien.org">www.incien.org</a>
Czechia	matériO Prague	VET professional	EU	professional	green	Towards sustainability	Textile and fashion	VET	<a href="https://www.materioprague.cz/towards-sustainability/">https://www.materioprague.cz/towards-sustainability/</a>	<a href="http://www.materioprague.cz">www.materioprague.cz</a>

