

**SELF-EVALUATION REPORT**

**SOCIETAL BENEFIT OF**

**RESEARCH, DEVELOPMENT AND**

**INNOVATION (R&D&I)**

**of the Faculty of Textile**

**Engineering, TUL**

**2014 – 2018**

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## SOCIETAL BENEFIT OF RID OF THE FACULTY OF TEXTILE ENGINEERING OF TUL

The FTE TUL evaluates societal benefit in keeping with its mission, visions and strategy. The outline of the evaluation report is based on the outline specified by the Ministry of Education, Youth and Sports.

### MISSION: The FTE TUL

- Provides education through a range of study programmes related to textile materials and technologies in Bachelor's, Master's and PhD courses;
- Runs its courses relying on qualified and highly motivated academic staff and PhD students;
- Offers a creative environment based on collaboration among experts whose competence spans a wide range of engineering and artistic fields;
- Focuses on scientific and research work while honouring the inseparability of education from research and science;
- Is involved in international collaboration including instruction in foreign languages (not only in accredited study programmes but also in custom-made lectures and courses), teacher and student mobility, courses in a foreign language and participation in international R&D projects;
- Is a partner in collaboration in research institutions and businesses je partner;
- Strives for high efficiency within TUL, relying on synergy processes among conveniently collaborating departments.

### VISION: The FTE TUL wants

- To be an internationally recognized faculty providing elite-level Bachelor's, Master's and PhD education in textile and other related branches.
- Affirm its respected position among faculties specializing in research and other creative work in the Czech Republic, Europe and worldwide;
- Enhance collaboration with industrial and other partners such as universities and other research institution in R&D and other creative activities and provide conditions for technology and knowledge transfer to society, and to do so through high-quality research and scientific work, inspiring and creative teaching and a university environment which is challenging while at the same time being open, free and kind.

### STRATEGY:

The strategic objective is to maintain, confirm and develop the position of the FTE TUL as a research-oriented faculty which is among the leading global academic and research institutions from the similar field with respect to changes to the structure and direction of the textile industry in the Czech Republic and the EDA.



## Science and research, development, innovation, artistic and other creative activities

TUL FTE conducts creative activities as defined by §1 of Act No. 111/1998 Coll., on Higher Education Institutions in the following areas:

- Fundamental research (funded from contributions and CSF funds)
- Applied research (funded from contributions, TACR funds, projects run by Czech ministries, joint research and commissioned research)
- Innovation activities (as part of supplementary activities in the form of commissioned jobs)
- Artistic creative work

TUL FTE's creative activities are based on its Strategic Plan. Aid is provided in particular for those research activities which are in keeping with the fast developing research trends. Scientific and research work is linked especially to those areas where the Faculty has traditionally had a high level of competence and quality staffing alongside with a high likelihood of receiving financial aid through various grant competitions. The science and research development of the FTE targets primarily the following areas:

1. **New materials.** Research and development of new materials in the field of clothing and technical textiles, development of composite structures containing inorganic fibres, nanoparticles and textile reinforcements and the design and evaluation of intelligent textiles.
2. **Metrology and new quality assessment methods.** Modelling the properties of fibre and textile formations using CAD, development of methods for evaluating the comfort of textiles, quality assessment, textile comfort and defects of textiles.
3. **Advanced textile technologies.** Modification and development of technologies for processing new materials, new sources of energy and new transport media in textiles, interdisciplinary use of textiles, use of optical fibres and shape memory materials for engineering products, development on the field of textile sensors and sensors suitable for use in textiles, Ecological aspects of new technologies.
4. **Use of nanotechnologies.** Research, development and use of nanotechnologies in textiles, production and use of nanofibres and nanofibre structures, application of nanoparticles for special effects.
5. **Application of results of creative work in product design and innovation.** Application of results of new material and technology research in product design and innovation. Development of new methods and forms of design work. Harmonizing the artistic and technological elements of design and maintaining artistic design concepts while applying scientific methods and procedures.

The following parameters are monitored as the key performance indicators of creative activities:

- Projects
- Publication activities
- Exhibition activities



### 3.1. General self-reflection on societal benefit

The Faculty of Textile Engineering (FTE) of the Technical University of Liberec (FTE TUL) is the only one in the Czech Republic to provide education across the entire field of textiles, conducts fundamental and applied research and development (R&D) from design and material to technology, quality assessment to a wide range of application areas. **It is one of the largest faculties in the EU involved in all-round textile material engineering.** Its scientific and research work is linked especially to those areas of technology and material research where the Faculty has traditionally had a high level of competence, quality staffing and many specialized laboratories with cutting-edge instruments.

The societal benefit it provides is the development of the knowledge base in a unique field, R&D in technology and material engineering with a wide range of application of fibrous structures in areas such as the automotive and construction industry, protection of people and equipment, sustainable development and electrical engineering, and the education of specialists for a large application field.

The FTE is a renowned leader in the field of nanofibres, with discoveries such as the new technology of producing nanofibre textiles making it one of the prestigious higher education institutions. This technology led not only to industrial-scale production of nanofibres but also products made of this material.

### 3.2. Applied research projects

The FTE TUL conducts applied research projects, often in collaboration with businesses, from various providers (most frequently the MIT - Ministry of Industry and Trade, TACR - Technology Agency of the Czech Republic, MH - Ministry of Health, MI - Ministry of Interior and MEYS - Ministry of Education, Youth and Sports). The projects included here were selected in such a way so as to demonstrate the width of application of fibrous textiles that matches the societal and knowledge benefit of the FTE. With each project the R&D area dealt with at the FTE as represented by the project is specified. Their societal relevance is indicated through specific results (for the full overview see the Appendix, tables 3.2.1 and 3.2.2)

1. Nanofibrous wound dressings ([FV10416](#)) – A nanofibre R&D field with health care applications. A nanofibre-based functional skin graft was developed. Its nanofibre layer supports wound healing through its morphology and physical properties, shortening the treatment time. This research has long-term applications, and the FTE TUL subsequently received permission to start clinical trials.
2. Textiles and clothing showing increased comfort intended for specific needs of children suffering from dermatological troubles. ([FV20287](#) – a health care application; a textile is being developed for patients with serious and large-scale skin conditions (EB, psoriasis etc.)
3. Survey, conservation and care about libraries collections after year 1800 - materials and technologies ([DF13P010VV004](#)) - R&D with applications in the area of protection and safeguarding of cultural heritage. A method and material for the conservation and protection of old prints were developed.
4. Intelligent textiles against CBRN (chemical, biological, radiological and nuclear) substances ([VI20172020059](#) – R&D with applications in civilian protection. A hybrid protective textile to capture chemical warfare agents and ionising radiation is being developed.

5. Proposal of new sophisticated 3D textile structures with elements of hi-tech and smart materials used for upholstery covering of car seats to improve their product capabilities ([TA04011019](#)) – R&D with applications in the area of technical and smart textiles. A new type of car upholstery for improved comfort and better moisture transport was developed.

### 3.3. Commissioned research

The FTE TUL's societal benefit is demonstrated by the wide range of businesses and institutions involved with collaboration with the Faculty. In line with its mission and vision, the FTE focuses on collaboration with textile and garment producers such as [SVITAP](#) and [Perla](#) and organisations dealing with the applications of fibrous structures (health care, automotive, security - [Johnson Controls](#), [Zentiva](#), [Škoda Auto](#), [DRDO](#)). The FTE benefits from collaboration in commissioned research (CR) in the following ways:

- Active involvement in the development of national strategies in the textile and clothing industry (see collaboration with associations and producer platforms - [ATOK](#), [CLUTEX](#), [ČTPT](#));
- Involvement with companies working on R&D projects (generally preferred by businesses as a result of the strategy of the Czech Republic);
- Collaboration with prospective employers (innovation of subjects, industry placements, internships, company tours for students, topics for Master's and Bachelor's theses directly from the industry);
- Collaborative work in new application fields.

The unique position of the FTE within the global scientific community the Faculty is involved in long-term collaborative work on activities commissioned by international clients. The volume of funds increases slightly year by year, with the extent of work being limited by the Faculty's capacity as its limited (see tables 3.3.1 and 3.3.2); both directions of collaboration (with Czech and international clients) are coordinated in compliance with the strategy of the FTE.

Opportunities for CR are searched for through contacts of the FTE's staff members in the national and international scientific community. The FTE TUL's administration provides consulting and advisory services (support) in drawing up contracts and their provisions (the Legal Department, Technology Transfer Department, Vice-Dean for R&D). Activities are recorded in the FTE's Annual Reports and in the centralised records of TUL (the HR Department and Accounting). The profit is accumulated and used to subsidise non-profit activities of the FTE TUL.

### 3.4. Revenue from non-public sources (except for grants and commissioned research) gained through research

The following activities are recorded by the FTE TUL as non-public sources of revenue (except for grants and commissioned research) (in the order of frequency): expert analysis, consultancy, testing, licensing fees and donations for R&D. The total sum of the incoming funds is generally constant and in keeping with the development strategy of the FTE and conforms to the size and capacity of the unit under evaluation. The most significant benefit of this kind of collaboration is the opportunity to make new contacts with prospective CR clients and subsequent planning of joint projects (for the full overview see the Appendix, table 3.4.1).



Opportunities for are searched for through contacts of the FTE's staff members in the national and international scientific community. The same rules apply as in the case of commissioned research (Chapter 3.3).

## RESULTS OF APPLIED RESEARCH

### 3.5. Results of applied research with existing or prospective economic impact on society

The monitored period 2014-2018 records the following results of applied research in terms of authorship / co-authorship of the FTE TUL's staff members: a total of 33 patents (of which three are European, one US patent and three other international patents), 48 utility models, five prototypes and 27 functional samples (according to the RIV). Below are the most significant areas of results:

#### A) Results already applied - Licences sold:

**Example:** A licensing agreement for [UV 28912](#) "A measuring device for monitoring the physiological comfort in the boundary surface layer of car seats". This solution was created above and beyond the scope of a joint project with the licensee - Adient Strakonice s.r.o.

#### B) Results already applied - A joint ownership agreement:

**Example:** FTR TUL and [Svitap J.H.J., s r.o.](#) are joint owners of intellectual property (Joint Intellectual Property Ownership Agreement from 11 March 2015),

- [UV 27368](#) - Textile composite
- [PV 307884](#) - A method of producing a textile composite used primarily for outdoor applications, which contains at least one polymer nanofibre layer, and a textile composite prepared using this method.

A licensing agreement for this intellectual property was subsequently signed between the licensors (TUL, Svitap J.H.J., s r.o.) and the licensee ([Nanomembrane s r.o.](#)). This intellectual property is further developed and improved through collaboration (a collaboration agreement and projects) so that the company could supply membrane clothing to the Slovak Army.

#### C) Most significant results to be applied:

**Example:** The European patent *A Method And Device For Fatigue Testing Of Photochromic, Fluorescent Or Phosphorescent Dyes* ([EP3077811A1](#)) is an invention related to a method of fatigue testing of photochromic, fluorescent and phosphorescing dyes. It is a unique measurement kit, and talks are under way with potential international buyers.

**Example:** Wound dressing (clinical trials under way); clinical trials (see Section 3.6) are conducted through collaboration with health care providers: the Regional Hospital in Liberec, Bulovka Hospital Prague and the University Hospital Královské Vinohrady Prague.

- A method of producing biodegradable and biocompatible nanofibre fabrics, particularly for wound dressings, and equipment for performing this method ([PV 2015-117](#))
- Skin and wound dressings containing cannabidiol and / or its derivate / derivatives, polymerous nanofibres and / or microfibers containing cannabidiol and / or its derivate / derivatives, and a method of producing polymerous nanofibres and / or microfibers containing cannabidiol and / or its derivate / derivatives ([PV 2015-404](#))
- Emergency and chronic wound dressings ([PUV 2018-34641, 31723](#))



**Example:** A set of intellectual property rights protecting the principles of alternate electrospinning:

- A method of producing polymerous nanofibres by electrospinning a polymer solution or melt in an electrical field, and a linear formation form polymerous nanofibres produced using this method ([PUV 304137](#)).
- A linear fibrous formation with a polymerous nanofibre shell enveloping the supporting linear formation making up the core, and a method of and equipment for its production ([PUV 306428](#)).
- A method of producing polymerous nanofibres using electrospinning a polymer solution or melt, an electrospinning electrode for this method and equipment for producing polymerous nanofibres fitted with at least one such electrode ([PUV 306772](#)).
- A method of producing polymerous nanofibres using electric or electrostatic spinning of a polymer solution or melt, an electrospinning electrode for this method and equipment for producing polymerous nanofibres fitted with at least one such electrode ([PUV 307745](#)).

A confidentiality agreement with an agent was signed for further talks.

### 3.6. Significant results of applied research with other than economic impact on society

The FTE records (distinguishes) this type of applied research results (creative work outputs) with other than economic impact on society (Appendix table 3.6.1):

#### A) Results of research with a long-term application potential time horizon

This refers to long-term research whose existing results already have a lot of potential to have impact on improving life quality.

**Example:** As part of its R&D work the FTE TUL also looks into the area of application of fibrous textiles in health care (wound dressings and tissue engineering). Table 3.6.1 describes three R&D results ([PV 2015-117](#), [PV 2015-404](#), [UV 31723](#)) which are protected through patent / utility model rights; based on this the FTE TUL produces material used for emergency and chronic wound dressings. It consists of a layer made from a nanofibre and microfiber material which is biocompatible and biodegradable. It works as a membrane, which means it is air permeable. **The new structure accelerates healing, thus shortening a patient's stay in hospital. This will lead to cost saving and improved health.** For the material to be certified as a medical device clinical trials are under way, a time demanding process for Class IIB medical devices. Verifying its full functionality is expected to lead to a strong position to search for a commercial partner.

**Example:** This [publication](#) describes the development of a 3D electrospun scaffold for tissue regeneration of thymus gland implants. J. Erben, a PhD student, worked as a member of the FTE TUL's R&D team with the Sloan Centre for Cancer Research (New York, USA) on a project called "Fibrous three-dimensional scaffolds for preparation of thymus organoid – T cells immunotherapy", which earned him the "Théophile Legrand Innovation Award Textile serving Human" in 2019. The production, characterisation and testing of biodegradable tissue scaffolds made up from microfibers electrospun from melts and electrospun nanofibres is proposed and described in an article in a trade journal. **They develop the potential to help combat autoimmune diseases.**

**Example:** Know-how ([published in the press](#)) describes the development of a nanofibre layer used to cover from the outside the anastomosis of a large intestine. After part of a large intestine affected by a carcinoma has been removed, the healthy parts of the organ are surgically joined using anastomosis. This location often causes post-surgery complications which, according to studies, lead





to death in 6–22% of patients as the content of the intestine may leak through the anastomosis, causing an infection in the body. The solution is unique in that it combines two materials - a hydrophilic nanolayer, which adheres to the wound, covers it and facilitates healing, and a hydrophobic top layer, which isolates the anastomosis from the abdominal cavity. **This leads to improved healing after large intestine surgeries.**

**Example:** This [article](#) deals with the production of small-diameter vascular grafts for surgical purposes. Research is supported by patent [306213](#). Jana Horakova, a PhD student at the FTE TUL, and her team came first in the prestigious “Théophile Legrand Innovation Award Textile serving Human” for research in this field. **It will lead to improved health.**

## B) Innovative technologies and materials used in creative artistic work

Processing fibrous materials using textile technologies is not a trivial task and it brings new challenges and opportunities. The FTE TUL’s strategy of development of R&D includes linking the technological and artistic sides of product design. The results of research into new materials and technologies are applied in product design and innovation, the new methods and forms of creative design and harmonizing artistic and technological design elements.

Both parts of product design (technical and artistic) are **linked to and inspired by each other, with their results activating contact among academic staff themselves, students and the general public.** Academics and students of the Department of Design at the FTE TUL present their works at national and international exhibitions and competitions.

**Example:** Student Z. Hrubošová created a collection of Braille-embossed clothing. She uses 3D printing to create embossed graphic images inspired by modern urban architecture which include information in Braille. This makes the embossed graphics functional as well, providing information about the colour of each garment, whether it is made of a transparent material and how to take care of it. She earned second place in the *Théophile Legrand Innovation Award Textile serving Human 2016*.

## COLLABORATION WITH NON-ACADEMIA AND THE TRANSFER OF TECHNOLOGIES

### 3.7. The most important contact between the FTE and the non-academia application / industry field

The FTE TUL selected the most important examples of contact with non-academia for the evaluated period in such a way so as to demonstrate the range of activities it monitors also in terms of the multiregional and nation-wide nature of collaboration. Various types of collaboration are often mutually linked. Collaboration includes:

#### A) Collaboration with trade chambers and associations and employer organisations

The FTE TUL is a member of [ATOK](#) (Association of Textile-Clothing–Leather Industry), [ČTPT z. s.](#) (Czech Technology Platform for Textile) and [Clutex z.s.](#) (Czech Technology Platform for Textile). It is a leader in long-term collaboration in the concepts of development of the textile and clothing industry, with the benefit of creating conditions for successful collaboration with many universities and institutions involved in textile and material engineering.



**Example:** The FTE was actively involved in the preparation, signing and implementation of the Sector Agreement for the Textile, Clothing, Leather and Shoemaking Industry in the Regions of Liberec and Hradec Kralove and Moravian-Silesian Region.

### **B) Creative work - R&D (projects, project applications, commissioned research, supplementary activities), collaboration in education**

**Example:** *NANOMEMBRANE s.r.o.* – Joint R&D projects, developing know-how in the area of application of nanofibrous layers acting as steam-permeable membranes. Students of the FTE are invited to do tours and industry placements at the company.

**Example:** *Ministry of Interior – Directorate General of Fire Rescue Service (HZS)* – The FTE completed several projects including a proposal for the technical specifications of kit components and personal protection equipment for Fire Services, quality assurance expert analysis and testing and the design and technical specifications of the *Fire Service uniform – PS II NG*. This design was accepted by the client for implementation and protected with industrial design rights.

**Example:** Defence Bio-Engineering and Electro-medical Laboratory (*DEBEL*), Defence Research and Development Organisation (*DRDO*), Ministry of Defence, Bangalore, India – The FTE completed a two-year contract (9.6 million CZK) for the research, design, development and supply of a modern shape-memory insulation material which responds and swells when exposed to low temperatures (-5 °C), thus capturing air for improved thermal insulation.

**Example:** *L&L products, s.r.o.* – Commissioned research in R&D of composite materials for the automotive industry (the contract is confidential); topics of Master's and Bachelor's theses are announced as part of supporting and developing education in accredited study programmes.

**Example:** *Rieter CZ s.r.o.* - A joint project (*Processing waste and recycled textile fibres*) is under way, with the company providing the opportunity for students to do industrial placements and company tours and offering training and internship for the FTE's staff, while the company's specialists give lectures and act as consultants and opponents for Bachelor's, Master's and PhD theses.

### **B) Creative work - Innovative technologies and materials used in creative artistic work**

The FTE presents innovative technologies and materials used in creative artistic work through exhibitions.

**Example:** The FTE holds exhibitions of works produced by its students and staff and a range of invited guests from the field of design, applied art, painting, photography and graphic art (9-10 exhibitions per year). (*Galerie N*)

### **C) Transfer of knowledge to the application field (contracts, collaboration, lectures for companies, promotional and information events).**

## **3.8. System and support of technology transfer and intellectual property protection**

The TUL has a system of services related to technology transfer (TT). The FTE collaborates within the TUL on the development of TT rules and uses services provided for TT (consulting and advisory support for agreements and contractual provisions) from the Legal Department, Technology Transfer Department and Vice-Dean for R&D. A special emphasis is placed on educating R&D staff. Selected members of staff receive training and subsequently share their know-how with their colleagues (training, good practices, shadowing, legal services and interpretation of internal

regulations). At the same time work is done on projects such as TACR Gama which aim at developing this area and actively incorporate commercialisation processes into day-to-day work.

The technology transfer system at the University is coordinated and described in the TUL's Guideline on Intellectual Property (IP) protection at TUL and commercialisation of R&D results. In keeping with the TUL's strategy the FTE prefers the following options (in the order of priority):

#### **A) IP owned solely by the TUL**

- Sale of licences (four licences are granted as at January 1 2020 (see table 3.5.1); talks are under way regarding five patents);
- Key results with large application potential expected to lead to long-term research and increased licensing potential have been selected. They include results in the field of medical applications where the expected application potential spans dozens of years. This intellectual property is protected and further developed through R&D.
- Sale patents

#### **B) IP jointly owned by the TUL and businesses (results of collaboration / projects)**

- Another opportunity to turn results into income is in patents / utility models jointly owned by the Faculty and companies that resulted from commissioned research and projects (e.g. TACR, MIT). In such cases collaboration agreements include provisions dealing with the use of results. Such provisions bind the party which carries out commercialisation activities to pay a percentage share of the annual production turnover. As at January 1 2020 the FTE TUL has 35 collaboration agreements in place which have provisions on using the jointly achieved results of R&D.

In terms of capacity, collaboration between the FTE and the application area is adequate. The results of collaboration are beneficial with respect to knowledge (knowledge contribution, development of applications and links to the FTE's educational activities) and finance (licensing fees, principal and supplementary activities etc.).

Based on long-term collaboration with businesses, and due to the fast innovation spiral, typical of the textile industry, the advancement of collaboration that led to commercialisation while final development resulted in progress in solution concepts which are not produced under protected IP at all or only short-term is also viewed as success. The Faculty strives to prepare RDI outputs for the proof of concept stage, with the subsequent industrial application to be conducted by a partner depending on their available capacity and funding. This type of collaboration results in monetarily non-measurable impact in the form of expanding the partnership base for preparing joint R&D projects and extending collaboration with prospective employers.

### **3.9. Strategies of setting up and supporting spin-off companies**

In keeping with the TUL's strategy this type of commercialisation of RDI results is not a priority at the FTE TUL and thus it is not pursued.

## RECOGNITION BY THE SCIENTIFIC COMMUNITY

### 3.10. Most notable individual R&D&I awards

The examples of the most notable international and Czech RDI awards for the evaluation period between 2014 and 2018 are divided into awards presented to academics and awards given to students.

#### A) Awards for academics

1. Prof. Ing. Jiří Militký, CSc. - **Lifetime Achievement Award in Textile Science** (2018) - given by the Association of Universities for Textiles (**AUTEX**), awarded at the AUTEX 2018 Conference (18<sup>th</sup> international conference held once every two years). Nicknamed the “Textile Oscar” by trade insiders, this award gives international recognition to the work of prof. Militký, the Faculty of Textile Engineering, TUL and generally the Czech Republic, confirming the high regard they are held in by the international community of experts in textile sciences.
2. Prof. Ing. Jiří Militký, CSc. - **TBIS Honorary Lifetime Contribution Award** (2016). The Textile Bioengineering and Informatics Society (**TBIS**) is a charity organisation founded with the aim to support, develop and promote all aspects of science and technology of bioengineering materials, fibres and textiles for studying the influence of fibres, textiles and clothes on human biology, medical science, behaviour and health along to the environment of human habitat.
3. Prof. Ing. Luboš Hes, DrSc., Dr.h.c. - **Innovation Award**, granted by **The Textile Institute Manchester** (2016). The Textile Institute gives a range of awards to its members and other non-member experts and specialists. Professor Hes received the award for technical innovation and innovation in the marketing and economic development of the textile field.
4. Doc. Ing. Antonín Havelka, CSc. – **TACR Utility of Solution Award** (2017). Applied research and development of the new generation of highly functional barrier thermal-control and thermal-insulation smart textiles for use in demanding and specific climatic conditions and the improvement of health based on new sophisticated types of chemical fibres and yarns. prof. RNDr. David Lukáš, CSc. – The **Gold Medal** from the International Engineering Fair (2017) for an inter-faculty development team of the Technical University of Liberec (FTE, FME) for a production line for nanofibre-containing composite materials.
5. Prof. RNDr. Oldřich Jirsák, CSc. - The **Medal of the Town of Liberec** for exceptional contribution in the field of nanotechnologies (2018). His team succeeded in developing a new unique technological process of producing nanofibres which made a breakthrough in opening up the new possibilities of using these materials in a range of industrial and medical areas. He has authored several dozen other patented inventions.
6. Ing. Roman Knížek, Ph.D. – The **Golden Idet Award** in the category Military and Security Logistics and Services(2015) for a new innovative rainproof / steam-permeable garment with nanofibre membrane.

#### B) Awards for PhD students

8. Ing. Markéta Klíčová, a PhD student – The **Innovator of the Year Audience Award** at the international conference The Falling Walls in Berlin (2018) for R&D, for developing a nanofibre plaster for improving post-surgery healing of the large intestine. In 2018 the Falling Walls Lab Competition was entered by over 3000 participants from 57 countries.
9. Ing. Jana Horáková, a PhD student – **Théophile Legrand Innovation Award Textile serving Human** (2016), 1<sup>st</sup> place for a project focusing on nanofibrous vascular grafts.



10. Ing. Zuzana Hrubošová - *Théophile Legrand Innovation Award Textile serving Human* (2016), 2<sup>nd</sup> place for embossing Braille onto clothing textiles using 3D print to allow the visually impaired to get the necessary information about their garments.

### 3.11. Recognition by the international community in R&D&I

As a uniquely positioned institution in the Czech Republic, the key element of the mission of the FTE TUL is a connection to the international community. The strategy is to provide wide-ranging support to academics in their international activities (such as the Mobility Fund of the FTE, project services and the International Relations Department at the FTE TUL). For the purposes of self-evaluation in recognition from the scientific community the FTE monitors the following:

#### A) Excellence in R&D activities - Evaluation of the results of the FTE TUL in international rankings

Materials Science - Textiles is the main research sub-area of the WoS where the FTE TUL is actively involved. With the total number of 251 documents between 2014-2018 in the Materials Science - Textiles research sub-area the TUL (FTE TUL) comes 7th among the other, approximately 2814 organisations in the world (of those 37.8% documents are in Q1 and 28.0% in Q2). (data retrieved on January 14 2019).

#### B) Membership of the FTE in EU associations / organisations

In keeping with its vision the FTE TUL is involved in creating EU-level strategies, is a member of the Association of Universities for Textiles (*AUTEX*) and the global *Textile ACADEMY*, Winthertur. As a member of the Association of Textile-Clothing-Leather Industry (*ATOK*) it takes part in *EURATEX* (*European Apparel and Textile Confederation*) meetings. The FTE TUL participates in activities related to international collaboration with the EU's *European Technology Platform - Fibres Textiles Clothing* in eight topic groups.

#### C) Accreditation of study programmes in English

Perceived by the FTE TUL as an important aspect of recognition by the international scientific community, all study programmes run at the FTE TUL are accredited by the European Federation of National Engineering Associations (*FEANI*) - a federation of professional engineers which unites national engineering associations from the 33 countries of the European Higher Education Area (EHEA). Also the industry organisation *The Textile Institute Manchester* granted international accreditations to all types of study programmes until 2021. Thirty-four of the total number of 61 PhD students are international, which is the maximum capacity with respect to the Faculty's size.

#### D) Active collaboration with international partners

Due to the geographical distribution of sources of raw materials for the textile industry the FTE's strategy includes expansion outside of the EU. This can be demonstrated by valid agreements (in effect) (87 agreements by continent: America (3), Europe (60), Asia (21), and Africa (3)).

#### E) Staffing links to the scientific community

- **Involvement in editorial councils (table 3.11.1)**

Materials Science - Textiles is one of the research sub-areas of the WoS where the FTE TUL is actively involved and which is of key significance for the Faculty in RDI. For 2018 the Journal Citation Reports index 24 trade journals in the Materials Science – Textiles research sub-area.



The FTE TUL has its academic staff members on the editorial councils of seven of those (according to AIS 2×Q1, 4×Q2, 2×Q3), which means that the Faculty's academic staff represent it on editorial councils of prestigious international textile journals which cover the entire spectrum of the textile field. The Faculty's academics are also members of editorial councils of many other reviewed trade journals, both local and international. The full lists for each year are included in the respective Annual Reports of the FTE TUL.

Since 1994 the Faculty of Textile Engineering of the TUL has been a co-publisher of the trade journal *Vlákna a textile (Fibres and Textile)*, ISSN: 1335-0617. (<http://vat.ft.tul.cz>) indexed on the SCOPUS database (<https://www.scopus.com/sourceid/17198>).

- **Invitation lectures given by experts from the evaluated unit (table 3.11.2)**

The FTE TUL holds in particularly high regard long-term invitation lecture tours of its experts. Below are some of the highlights:

- Prof. Neckář – 15<sup>th</sup> annual edition of a month-long cycle of lectures Theory of Yarn Structures at the Indian Institute of Technology Delhi ([link](#))
- Regular lecturing in the Master's study programme Textile Engineering guaranteed by Ghent University, Belgium, as part of Autex activities. In 2018 two experts travelled abroad for a week-long lecture stay funded through Erasmus+ to 'Gheorghe Asachi' Technical University of Iasi, Romania (prof. Wiener – Dyeing of textiles, printing, textile chemistry, finishing of textiles, and doc. Rajesh Mishra – Introduction to Nanotechnology, Nanoscale Phenomena, Mechanical Properties in Nanoscale Materials, Carbon Based Nanomaterials, Nanofibres, Nano Particles, Nanocellulose, Nanocomposites, Exercises.

- **Lectures of international experts at the FTE TUL (table 3.11.3)**

- **As part of international conferences and seminars (100 + participants)**

Annually the FTE TUL holds one international conference attended by more than 100 participants: Examples include:

*STRUTEX* International Conference of Structure and Structural Mechanics of Textiles

*Fibre Society Spring Conference* (Fibres for Progress),

*9th Central European Conference* (Fibre-Grade Polymers, Chemical Fibres and Special Textiles)

*NESAT XIII* (North European Symposium for Archaeological Textiles)

Invitation lectures are given by top international experts (selected names are listed in table 3.11.3). Experts from the Faculty are members of and work in organizational and scientific groups of a range of other high-ranking international conferences.

- **As part of short-term stays of international R&D staff**

Every year there are approximately 15-20 stays of international experts (week-long on average). These stays always include lectures.

- **Elected membership of academics in industry associations (table 3.11.4)**

The Faculty's staff are members of many scientific councils, trade organisations and administration boards. Some selected membership examples are shown in the table.



## POPULARISATION OF R&D&I

### 3.12. Most significant R&D&I popularisation activities and communication with the public

The target groups the FTE TUL focuses its popularisation activities on is the general public and prospective students, with emphasis placed on the synergy effect of such activities. The key activities include:

#### A) Presenting R&D results in popular science form through various media outlets

In particular long-term research outputs are presented which are in the pre-commercialisation or commercialisation stage. In line with the strategy of the TUL (in collaboration with the TUL's Marketing Department and Press Officer) press releases, press conferences and other related events are prepared.

**Example:** Road Safety Day (2014), Polygon Most. During this all-day event the FTE and BESIP introduced the concept of safety features containing optical fibres for a wide range of applications (safety jackets, rucksacks, prams and bicycles etc.) to increase road safety.

**Example:** As the main guest of the popular science programme Hyde Park Civilisation, professor Jirsák (2017) introduced the Faculty and the University as the Mecca of nanotechnologies and talked about the current and prospective applications of nanofibres.

#### B) Presentation of using smart and highly functional textiles in artistic outputs (fashion shows, exhibitions)

**Example:** The work of the University's *Galerie N*, Jablonec n. N. The Department of Design of the FTE TUL holds nine exhibitions a year at the Galerie N in the field of design, applied art, art trades and fine arts. p

**Example:** EXPO (2015) Milan, IT. The name of the exhibition was Drops for Life (within the exhibition team of Feeding the Planet, Energy for Life). The textile gallery at the Czech pavilion opened as part of ATOK Design Days at the beginning of August, and the selected presentations were given by the FTE alongside with the other textile industry delegates. Innovative works of students were presented such as Jakub Rasl's tapestry, a special Jacquard fabric with fluorescent yarn (Irena Čvančarová) and a Jacquard fabric with patterns using anaglyph 3D effects. Two information panels were also displayed which demonstrated the link between R&D and arts, showing the aesthetic quality of nanofibre structures and their application in artistic work and the opportunity to use optical fibres in clothing and other technical textiles.

**Example:** Designblok Prague. (2017, 2018). Presentation of students' works.

**Example:** Student design at the Prague Castle. (2017). Presentation of students' works: "TULáci".

#### C) Search for and long-term work with talented individuals in primary and tertiary education

**Example:** (2014-2017) As part of its activities aimed at motivating prospective engineering students the FTE TUL's staff were actively involved in the OP VK, University-wide **Open University** project. The objective of the project was to introduce in a systematic and continuous manner results of the TUL's R&D work to the public not only in and around Liberec but also in other regions in the Czech Republic outside of Prague. Another important activity is to search for and work long-term with



talented individuals in primary and tertiary education, especially those who are likely to become researchers in engineering and natural science fields developed at the TUL. Activities were conducted with the aim enhance motivation for further study in engineering areas; they included company tours, promotional presentations at primary and high schools, regular courses for primary and high school students run throughout the year and a summer school for primary-level pupils. Children's University is an all-year-round free-time informal education project for children and youth between six and nineteen years old. It is conducted beyond compulsory education and includes elements of "play", with children pretending to be university students.

**Example:** (2015-2018) An important event is regular involvement as a co-organiser in the Clothing and Textile competition for primary and high school students. It is regularly attended by ten schools from the Liberec Region and thirty others from all over the Czech Republic (a total of 500 primary and high school students). The event links the engineering and artistic side of textiles and clothing, presents the work of textile companies to students, includes workshop to show textile techniques in action, presents students' works in the selected categories and grants wards to the best collections. The main prize in one of the categories is participation at the Fashion Week in Kosice and a fashion show at the Prague Castle. As part of the event students were also taken on a tour of the FTE TUL's departments.

**Example:** (2017) An all-day presentation at the following events: "Living Library - Careers" – IQLANDIA Liberec (550 Year 9 pupils) and Aldus Hradec Králové 1x, (doc. Ing. Pavel Pokorný Ph.D., PhD students from the KNT)

#### D) Open days, tours, workshops, presentations

**Example: Regular events:** Open Days (February, November - prospective students), tours (as per demand - three times a year for high school students and graduates; individual arrangements for companies and international partners); promotional presentations at primary schools - "How the Little Mole Got His Trousers" - presentation of textile techniques 2-4 times per year).

**Example:** (2017) Future Port Prague - The first edition of the annual one-day festival of modern technologies - presentation of nanofibre production.





## APPENDICES (TABLE SECTION)

### 3.2 Applied research projects

#### 3.2.1 Projects supported by a provider from the Czech Republic

As the beneficiary						
Provider	Project title	Support (EUR thousand)				
		2014	2015	2016	2017	2018
MoI	Research of the possibilities for application of a new materials (focusing on nano-materials) and advanced technologies for protection of people against the exposure to CBRN materials, with emphasis on critical infrastructure ( <a href="#">VG20102014049</a> )	44,83				
MoEYS	Nanofibrous materials for tissue engineering ( <a href="#">ED3.1.00/14.0308</a> )	94,90	45,62			
MoEYS	Support of the creation of excellent research and development teams at the Technical University of Liberec ( <a href="#">EE2.3.30.0065</a> )	234,63	288,44			
GACR	Polymer solutions in an external field: molecular understanding of electrospinning ( <a href="#">GAP208/12/0105</a> )	29,85	29,85			
MoC	Survey, conservation and care about libraries collections after year 1800 - materials and technologies ( <a href="#">DF13P010VV004</a> )	53,24	53,20	53,24	51,93	
MoH	Nanofibrous Biodegradable Small-Diameter Vascular Bypass Graft ( <a href="#">NV15-29241A</a> )		52,94	66,62	62,13	58,21
MoEYS	Development of hemocompatible electrospun scaffolds ( <a href="#">8J18DE012</a> )					2,91
GACR	Improved growth of human skin cells on biomimetic nanofibrous matrices for active wound healing ( <a href="#">GA17-024485</a> )				38,00	38,00
TACR	Sophisticated hybrid tapes for fabrication of composites by precise winding ( <a href="#">TJ01000292</a> )				13,64	50,85
MoI	Smart textile against CBRN agents ( <a href="#">VI20172020059</a> )				102,04	93,59
MoEYS	CxI TUL Management Mechanisms with a focus on increasing the quality of the results of R&D&I activities ( <a href="#">EF16_028/0006198</a> )				161,03	119,56
MoEYS	Hybrid Materials for Hierarchical Structures ( <a href="#">EF16_019/0000843</a> ) – FME, FTE, CxI					776,13
MoEYS	Student Grand Competition ( <a href="#">SGS</a> )	130,44	142,92	160,50	159,59	206,51
<b>Total</b>		<b>587,90</b>	<b>612,98</b>	<b>280,36</b>	<b>588,36</b>	<b>1345,76</b>
As another participant						
Provider	Project title	Support (EUR thousand)				
		2014	2015	2016	2017	2018
TACR	Interdisciplinary research and development of special functional textiles and extraordinary physiologically user friendly end-products based on new generation cellulose or synthetic fibres designed for specific innovative market suitable applications ( <a href="#">TA01011253</a> )	65,23				
TACR	Water nanodispersion for functional surface treatment ( <a href="#">TA01010613</a> )	14,94				



MoIT	Environmentally Acceptable Ways of Felting (FR-TI4/296)	13,34				
TACR	Nanofibres and abrasive nanoparticles as a base of new generation tools for fine polishing of surfaces (TA03010609)	38,11	38,11			
TACR	Proposal of new sophisticated 3D textile structures with elements of hi-tech and smart materials used for upholstery covering of car seats to improve their product capabilities (TA04011019)	15,13	40,99	38,22	37,59	
TACR	Matrix systems for healing of skin defects for human and veterinary use (TA04010065)	7,88	15,47	14,76	14,57	
TACR	Heat exchangers with polymeric hollow fibres for energetic systems of buildings (TH01020139)		9,30	9,30	9,34	9,34
TACR	Energy efficient line lighting systems (TH01021163)		37,10	43,23	38,22	18,91
MoIT	Intelligent textiles for seniors (EG15_019/0004528)					7,55
MoIT	Sky Paragliders a.s. - research and development of technical textile for airplane saving parachute systems (EG15_019/0004588)					18,34
MoIT	Meditex - research and development of new types of advanced textile materials with high potential intended to be applied in special textiles for medical and convalescent care (FV10098)			27,50	53,58	53,58
MoIT	Hybrid safety products (FV10356)			14,01	52,31	52,31
MoIT	Nanofibrous Wound Dressing (FV10416)			30,19	95,65	95,65
MoIT	Senior Tex - Smart Modular clothing and textile products with integrated electronic microsystems for improving the health care of the aging population and handicap people (FV10111)			20,03	55,93	55,71
MyEYS	Wearable IoT (LTE217018)					9,68
MoIT	TEXDERM - Textiles and clothing showing increased comfort intended for specific needs of children suffering from dermatological troubles (FV20287)				20,62	41,66
MoH	Treatment of diabetic wounds using nanofibrous dressings releasing platelet lysate components (NV18-01-00332)					32,06
TACR	PROSYKO - Pro-Active System of Commercialization at TU Liberec (TG01010117) – CxI – FTE - sub-projects	9,61	24,22	45,83	42,55	30,83
MyEYS	Innovative products and environmental technologies (ED3.1.00/14.0306) – CxI - FTE sub-projects	188,38	125,95			
<b>Total</b>		<b>352,63</b>	<b>291,14</b>	<b>243,06</b>	<b>420,36</b>	<b>425,60</b>

### 3.2.2 Projects supported by a provider from another country

As the beneficiary
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Provider	Project title	Support (EUR thousand)				
		2014	2015	2016	2017	2018
Total						
As another participant						
Provider	Project title	Support (EUR thousand)				
		2014	2015	2016	2017	2018
Total						

### 3.3 Contract research

#### 3.3.1 Research work contracted by a client from the Czech Republic

Client	Research title	Revenues (EUR thousand)				
		2014	2015	2016	2017	2018
Svitap JHJ spol. s. r.o.	Development of the technology and the innovation of new machinery for producing nanolayers and the application of the new generation of nanofibrous membranes for barrier-free clothing. (RIV/46747885:24410/14:#0003867)	7,85				
ČTPT z.s.	Selected topics of the application of textile structures (RIV/46747885:24410/14:#0003866)	7,47				
Jonson Controls Fabrics a.s.	Special measurement of technical fabrics (RIV/46747885:24410/14:#0003868)	1,77				
Svitap JHJ spol. s. r.o.	2015 Annual Report (RIV/46747885:24410/15:00003350)		12,98			
Grammar AG	Report of car seat tests for Grammer (RIV/46747885:24410/15:00003340)		6,26			
Pumax spol. s r.o.	Seamless - expert development (RIV/46747885:24410/15:00003503)		4,67			
ČVUT	Artificial muscle (RIV/46747885:24410/15:00003329)		5,96			
Zentiva k.s.	Development and production of ODF (RIV/46747885:24410/15:00003328)		26,15			
La L Products s.r.o.	Patterning using pilot line STRUTO (RIV/46747885:24410/15:00003327)		2,69			
Perla, netkaný textil, a.s.	Using PERVIN for electrospinning (RIV/46747885:24410/16:00003628)			3,70		
Alucon, s.r.o.	Design of storage jets for interoperable storage tows (RIV/46747885:24410/16:00003609)			2,24		
Zentiva k.s.	Development of new products (RIV/46747885:24410/16:00002215)			39,23		
Škoda Auto	Feasibility study-textile evaluation. A report from the first project stage (RIV/46747885:24410/16:00003629)			4,61		
H&D a.s.	Development of high durability working gloves for hot operations (RIV/46747885:24410/16:00003634)			3,36		
Grund a.s.	3D fabric for specific end use3D (RIV/46747885:24410/16:00003717)			11,21		

L a L Products s.r.o.	L L Products (RIV/46747885:24410/17:00004985)				34,30	
Zentiva k.s.	Development of ODF films (RIV/46747885:24410/17:00004989)				54,25	
<b>Total</b>		<b>17,09</b>	<b>58,71</b>	<b>64,36</b>	<b>88,55</b>	

### 3.3.2 Research work contracted by a foreign client

Client	Research title	Revenues (EUR thousand)				
		2014	2015	2016	2017	2018
Mubea Carbo Tech GmbH	Mechanical tests of exterior car parts for a project (RIV/46747885:24410/14:#0003869)	9,27				
Defence Bio-Engineering and Electro-medical Laboratory (DEBEL), Defence Research and Development Organization (DRDO)	PRELIMINARY CONCEPT REVIEW DOCUMENT FOR Research services, design, development & supply of advanced insulation materials (RIV/46747885:24410/14:#0003870)	126,10				
Defence Bio-Engineering and Electro-medical Laboratory (DEBEL), Defence Research and Development Organization (DRDO)	FINAL TECHNICAL REPORT ON THE COLLABORATIVE R&D EFFORT - PHASE V (RIV/46747885:24410/16:00003795)		140,11	89,80		
<b>Total</b>		<b>135,36</b>	<b>140,11</b>	<b>89,80</b>		

### 3.4 Revenues from non-public sources (besides grants or contract research)

#### 3.4.1 Overview of revenues from non-public sources raised for the 2014–2018 reporting period

Revenue type	Revenues (EUR thousand)				
	2014	2015	2016	2017	2018
Expert analysis, consulting, testing as part of supplementary activities	22,72	34,57	80,28	84,84	53,45
Donations for R&D	5,45				
Licences	10,47	9,08	4,75		
<b>Total</b>	<b>38,65</b>	<b>43,65</b>	<b>85,03</b>	<b>84,84</b>	<b>53,45</b>

### 3.5 Applied research results with an economic impact on society

#### 3.5.1 Overview of applied research results in the 2014–2018 reporting period

Results	Year	Title
<b>European patent</b>		
<b>American patent</b>		
US10041189B2 ( <a href="#">link</a> ) The result of the patent is, used by Nanoprogres, z.s., Pardubice, on the basis of the Works Contract of 7. December 2017. (TUL: 60%)	2018	A method of production of polymeric nanofibres using electrospinning of a polymer solution or melt in an electric field
<b>Czech licensed patent</b>		
307613 ( <a href="#">link</a> ) Licensing talks under way (FT: 16.6%) Joint ownership agreements?	2018	A louvre for louvre fire protection doors, especially high-speed louvre fire protection doors, and louvre fire protection doors, especially high-speed fire protection doors with these louvres
307377 ( <a href="#">link</a> ) The patent is used based on a licensing agreement by Jap - Jacina, s.r.o. (FT: 12.5%)	2018	A mobile flood protection wall
306772 ( <a href="#">link</a> ) The result of the patent is used by Nanoprogres, z.s., Pardubice, on the basis of the Works Contract of 18 December 2017, part Granting Know-How. (FT: 50%)	2017	A method of producing polymerous nanofibres using electrospinning a polymer solution or melt, an electrospinning electrode for this method and equipment for producing polymerous nanofibres fitted with at least one such electrode
306428 ( <a href="#">link</a> ) The result of the patent is, used by Nanoprogres, z.s., Pardubice, on the basis of the Works Contract of 11 December 2017, part Granting Know-How. (FT: 50%)	2016	A linear fibrous formation with a polymerous nanofibre shell enveloping the supporting linear formation making up the core, and a method of and equipment for its production
305698 ( <a href="#">link</a> ) A licensing agreement with AQUATEST a.s. from 28 April 2016, valid until 28 April 2018. (FT: 50%)	2015	A biomass carrier for bioreactors
305702 ( <a href="#">link</a> ) A joint ownership agreement (FTE, GRUND) (FT: 60%)	2015	A textile anti-slip mat, especially a bathroom mat
305675 ( <a href="#">link</a> ) A joint ownership agreement (FTE, VIOLA NANOTECHNOLOGY) (FT: 75%)	2015	A method of increasing the hydrostatic resistance of polymer nanofibre layers, a layer of nanofibres with increased hydrostatic resistance, and a multi-layer textile composite material containing at least one such layer
304873 ( <a href="#">link</a> ) ?	2014	Pressure and/or force sensor
<b>Other foreign patents</b>		
JP6360492B2 ( <a href="#">link</a> ) The result of the patent is used by Nanoprogres, z.s., Pardubice, on the basis of the Works Contract of 7 December 2017 (TUL: 60%)	2018	A method of producing a polymer nanofibres by spinning a solvent solution or melt of polymer in electric field, and the linear form of the polymer nanofibres prepared by this method

RU2672630C2 ( <a href="#">link</a> ) The result of the patent is used by Nanoprogres, z.s., Pardubice, on the basis of the Works Contract of 7 December 2017 (TUL: 60%)	2018	Method for production of polymeric nanofibres and linear formation from polymeric nanofibres prepared by this method
CN105008600B ( <a href="#">link</a> ) no licence (TUL: 60%)	2017	A method of producing polymerous nanofibres using electrospinning a polymer solution or melt, and a linear formation from polymeric nanofibres prepared by this method
<b>Licences sold</b>		
UV 28912 ( <a href="#">link</a> ) The TUL granted a licence to ADIENT Strakonice, s.r.o. (FT TUL: 100%)	2015	A measuring device for monitoring the physiological comfort in the boundary surface layer of car seats
UV 27368 ( <a href="#">link</a> ) The TUL and SVITAP (a joint ownership agreement) – granted a licence to NANOMEBRANE, s.r.o.	2014	Textile composite
307884 ( <a href="#">link</a> ) The TUL and SVITAP (a joint ownership agreement) – granted a licence to NANOMEBRANE, s.r.o.	2019	A method of producing a textile composite used primarily for outdoor applications, which contains at least one polymer nanofibre layer, and a textile composite prepared using this method
UV 21770 ( <a href="#">link</a> ) A licensing agreement with Kalas Sportswear s.r.o. Tábor	2014	A device to indicate change of direction and braking
<b>Significant analyses / surveys / studies</b>		
Not applicable		
<b>Spin-off with a stake held by the evaluated unit</b>		
Not applicable		
<b>Spin-off with no stake held by the evaluated unit</b>		
Not applicable		
<b>Prototypes</b>		
Not applicable		
<b>Varieties and breeds</b>		
Not applicable		
<b>Others (utility models)</b>		
PUV 29028 ( <a href="#">link</a> ) TUL(30%) and VÚB(70%) - a joint ownership agreement	2015	Fabric, especially knitwear, for protecting users in cold climates
PUV 28953 ( <a href="#">link</a> ) TUL(30%) and VÚB(70%) - a joint ownership agreement	2015	Fabric, especially knitwear, for protecting users in cold climates
PUV 27192 ( <a href="#">link</a> ) TUL and POLPUR, s.r.o. - a joint ownership agreement	2014	A layered material / fabric for polishing hard surfaces
PUV 31332 ( <a href="#">link</a> ) TUL(30%) and VÚB(70%) - a joint ownership agreement	2017	Knitted fabric used especially for bedclothes, made from blended yarns
PUV 27338 ( <a href="#">link</a> ) TUL(30%) and VÚB(70%) - a joint ownership agreement	2014	Fabric, especially knitwear, used as clothing for RA patients

### 3.6 Significant applied research results with an impact other than an economic one on society

#### 3.6.1 Overview of applied research results for the 2014–2018 reporting period with an impact other than an economic one on society

Result type	Name	Anticipated impact
1) F <sub>uzit</sub>	<p>Chvojka J, Lukáš D, Mikeš P, et al. Emergency and chronic wound dressing. [utility model]. Registered on 24 April 2018 under No. PUV 2018-31723. (<a href="#">link</a>)</p> <p>Dzan L, Krchová S, Chvojka J, et al. A method of producing a formation from biodegradable and biocompatible nanofibres, especially for wound dressings, and a device for this method. [invention application]. Submitted on 20 February 2015 under No. PV 2015-117. (<a href="#">link</a>)</p> <p>Chvojka J, Lukáš D, Kuželová-Košťáková, et al. Skin and wound dressings containing cannabidiol and / or its derivate / derivatives, polymerous nanofibres and / or microfibers containing cannabidiol and / or its derivate / derivatives, and a method of producing polymerous nanofibres and / or microfibers containing cannabidiol and / or its derivate / derivatives. [invention application]. Submitted on 16 June 2015 under No. PV 2015-404. (<a href="#">link</a>)</p>	<p>Materials designed to act as emergency and chronic wound dressings. They consist of a layer of nanofibres and microfibers made of a biocompatible and biodegradable material acting as a membrane, thus being permeable. The new structure enables faster healing and shorter hospital treatment, leading to cost saving and improved health of individuals. For the material to be certified as a medical device clinical trials are under way, a time demanding process for Class IIB medical devices. Verifying its full functionality is expected to lead to a strong position to search for a commercial partner. <b>In the future this method of using textile layers should help improve patients' health.</b></p>
2) J <sub>imp</sub>	<p>Erben J, Jencova V, Chvojka J, Blazkova L, Strnadova K, Modrak M, Kuzelova Kostakova E. The combination of meltblown technology and electrospinning – The influence of the ratio of micro and nanofibres on cell viability. <i>Materials Letters</i> <b>173</b> (2016), 153-157. (<a href="#">link</a>)</p>	<p>The article proposes and describes production, characterisation and testing of biodegradable tissue scaffolds made up from microfibers electrospun from melts and electrospun nanofibres. This material is used to develop 3D electrospun structures (scaffolds) for tissue regeneration of thymus gland implants. American scientists grow stem cells for these unique tissue scaffolds to create a functional organoid. The project “Fibrous three-dimensional scaffolds for preparation of thymus organoid – T cells immunotherapy” received the Théophile Legrand Innovation Award Textile serving Human 2019. <b>This</b></p>

		<b>method of using textiles could help combat autoimmune diseases in the future.</b>
3) J <sub>imp</sub>	<p>Rosendorf J, Horakova J, Klicova M, et al. Experimental fortification of intestinal anastomoses with nanofibrous materials in a large animal model. <i>Scientific Reports</i> <b>10</b>, Article number 1134, Nature Publishing group, 2020. 12 pages. ISSN 2045-2322. (<a href="#">link</a>)</p>	<p>The team of Markéta Klíčová and Jana Horáková at the Department of Nonwoven Textiles and Nanofibre Materials of the FTE TUL has been developing a nanofibre layer to cover from the outside the anastomosis of a large intestine. After part of a large intestine affected by a carcinoma has been removed, the healthy parts of the organ are surgically joined using anastomosis. This location often causes post-surgery complications which, according to studies, lead to death in 6–22% of patients as the content of the intestine may leak through the anastomosis, causing an infection in the body. The solution is unique in that it combines two materials - a hydrophilic nanolayer, which adheres to the wound, covers it and facilitates healing, and a hydrophobic top layer, which isolates the anastomosis from the abdominal cavity. <b>This method of using textile layers could lead in the future to improved healing after large intestine surgeries.</b> (<a href="#">link</a>)</p>
4) J <sub>imp</sub> , P	<p>Yalcin I, Horakova J, Mikes P, Gok Sadikoglu T, Domin R and Lukas D. Design of Polycaprolactone Vascular Grafts. <i>Journal of Industrial Textiles</i> <b>45</b>(5), 2016, 813-833. (<a href="#">link</a>)</p> <p>Horáková J, Mikeš P, Jenčová V, Chvojka J, Lukáš D, Šaman A. Vascular grafts, especially small-diameter vascular grafts [patent]. Granted on 24 August 2016 under No. 306213. (<a href="#">link</a>)</p>	<p>Vascular grafts are frequently used in surgery. There are three types of grafts divided according to the diameter of the artificial vessel. Small vascular grafts are very difficult to produce. The article describes the production of small-diameter vascular grafts to be used in surgery. Research is supported by patent 306213 - Vascular grafts, especially small-diameter vascular grafts.</p> <p>Jana Horakova, a PhD student at the FTE TUL, and her team came <b>top at the prestigious Théophile Legrand Innovation Award Textile serving Human</b> for research in this area. (<a href="#">link</a>).</p>
5) O	<p>Hrubošová Z. 3D printing of Braille Labelling for Blind People. In: <i>Proceedings of The 44th Textile Research Symposium</i>. 14th-16th December 2016. Indian Institute of Technology, Delhi, India.</p>	<p>The paper deals with the embossing of Braille on clothing fabric using 3D print. The visually impaired can get the necessary information about their garments, being able to read symbols about care for clothing, colour and other data. The author came second in the international competition <b>Théophile Legrand Innovation Award Textile serving Human 2016</b>.</p>

Note: Provide and describe up to five results (the type of result according to the Definition of result types) already applied in the field or realistically poised to be applied in the field. Typically they are results from humanities and social sciences. Briefly describe their anticipated impact.





### 3.11 Recognition in the international R&D&I community

#### 3.11.1 Participation of the evaluated unit's academic staff on the editorial boards of international scientific journals in the 2014–2018 reporting period

Name, surname and title(s) of the evaluated unit's member of staff	Title, publisher, city(-ies) and country(-ies) of origin of the scientific journal
Prof. Ing. Jiří MILITKÝ, CSc. 2014-2016	<i>Composites Part B: Engineering</i> , Elsevier SCI LTD. ISSN: 1359-8368. (Editorial Board)  JCR 2018 Materials Science-Multidisciplinary (AIS Q1 5/88) JCR 2018 Materials Science-Composites (AIS Q1 4/25)
Prof. Ing. Luboš HES, DrSc., Dr.h.c.	<i>Journal of Industrial Textiles</i> , SAGE Publication INC, Thousand Oaks, CA, USA. ISSN: 1528-0837. (Editorial Advisory Board)  JCR 2018 Materials Science-Textiles (AIS Q1, 3/24)
Prof. Ing. Luboš HES, DrSc., Dr.h.c.	<i>Textile Research Journal</i> , SAGE Publication LTD, London, England. ISSN: 0040-5157. (Editorial Advisory Board)  JCR 2018 Materials Science-Textiles (AIS Q1 4/24)
Prof. Ing. Luboš HES, DrSc., Dr.h.c.	<i>Journal of Natural Fibres</i> , Taylor & Francis, Philadelphia, PA, USA. ISSN: 1544-0478. (Editorial Board)  JCR 2018 Materials Science-Textiles (AIS Q2 11/24)
Prof. Ing. Jiří MILITKÝ, CSc.	<i>The Journal of The Textile Institute</i> , Taylor & Francis LTD., Oxon, England. ISSN: 0040-5000. (Editorial Board)  JCR 2018 Materials Science-Textiles (AIS Q2 7/24)
Prof. Ing. Jiří MILITKÝ, CSc.	<i>Autex Research Journal</i> , Technical University Lodz, Lodz, Poland. ISSN: 1470-9589. (Scientific Programming Board)  JCR 2018 Materials Science-Textiles (AIS Q2 9/24)
Prof. Ing. Jiří MILITKÝ, CSc.	<i>Fibres &amp; Textiles in Eastern Europe</i> , Inst. Chemical Fibres, Lodz, Poland. ISSN: 1230-3666. (Scientific Board)  JCR 2018 Materials Science-Textiles (AIS Q3 14/24)
Prof. Ing. Luboš HES, DrSc., Dr.h.c.	<i>Fibres &amp; Textiles in Eastern Europe</i> , Inst. Chemical Fibres, Lodz, Poland. ISSN: 1230-3666. (Scientific Board)  JCR 2018 Materials Science-Textiles (AIS Q3 14/24)
Prof. Ing. Luboš HES, DrSc., Dr.h.c.	<i>Journal of Engineered Fibres and Fabrics</i> , SAGE Publication LTD, London, England. ISSN: 1558-9250. (Editorial Board)  JCR 2018 Materials Science-Textiles (AIS Q2 10/24)
Prof. Ing. Luboš HES, DrSc., Dr.h.c.  Until 2018	<i>Textil ve Konfeksiyon</i> , EGE UNIVERSITY, Izmir, Turkey. ISSN: 1300-3356. (Scientific Board)  JCR 2018 Materials Science-Textiles (AIS Q2 10/24)

#### 3.11.2 The most significant invited lectures by the evaluated unit's academic staff at institutions in other countries during the 2014–2018 reporting period

Name, surname and title(s) of the evaluated unit's member of staff	Invited lecture title	Name of the host institution, conference or other event

Prof. Ing. Jiří MILITKÝ, CSc. Plenary speaker	Electrically Conductive Structures for Protective and Smart Textiles ( <a href="#">link</a> )	Advances in Textile Materials and Processes (ATMP 2018), 19.-20.11.2018, IIT Kanpur, India
Prof. Ing. Jiří MILITKÝ, CSc. Plenary lecture	Advanced Textiles with Electromagnetic Shielding Functions	The 9th Textile Bioengineering and Informatics Symposium (TBIS 2016), 12.-15.7.2016, Melbourne, Australia
Prof. Ing. Jiří MILITKÝ, CSc. Medal lecture	Advanced Carbon Structures from Waste ( <a href="#">link</a> )	The 11th Textile Bioengineering and Informatics Symposium (TBIS 2018), 25.-28.7.2018, Manchester, UK
Prof. Ing. Jiří MILITKÝ, CSc. Keynote speech	Textile based line lighting system	The 7th Textile Bioengineering and Informatics Symposium (TBIS 2014), 6.-8.8.2014, Hong Kong, China
Prof. Ing. Jiří MILITKÝ, CSc. Plenary lecture	Recent Development in the Field Of Technical Textiles ( <a href="#">link</a> )	International conference on Advance Materials, Textiles and Processes (ICAMTP-17), 14.-15.10.2017, Kanpur, India
Prof. Ing. Jiří MILITKÝ, CSc. Keynote lecture	Nano Membranes For Wastewater ( <a href="#">link</a> )	International Conference on Wastewater Management (ICWW 2017), 17.-19.8.2017, Coimbatore, India
Prof. Ing. Luboš HES, DrSc., Dr.h.c. Plenary lecture	Thermophysiological and Barrier Properties of Sport and Protective Clothing in Wet State ( <a href="#">link</a> )	12th Clotech Conference 2017: Innovative Materials and Technologies in Made-up Textile Articles, Protective Clothing and Footwear, 11.-14.2017, Lodz, Poland
Mohanapriya VENKATARAMAN, M.Tech., Ph.D. Plenary lecture	Selected Applications of Linear Composites with Side Emitting Optical Fibres ( <a href="#">link</a> )	12th Clotech Conference 2017: Innovative Materials and Technologies in Made-up Textile Articles, Protective Clothing and Footwear, 11.-14.2017, Lodz, Poland
Prof. Ing. Jiří MILITKÝ, CSc. Keynote Speech	Multilayered perpendicular nonwovens for advanced thermal and acoustic insulation ( <a href="#">link</a> )	45th Textile Research Symposium in Kyoto 2015, 14.-16.9.2015, Kyoto, Japan
Prof. Ing. Bohuslav NECKÁŘ, CSc. A cycle of invitation month-long lecture visits	Theory of Yarn Structures ( <a href="#">link</a> )	Indian Institute of Technology Delhi, 2015, New Delhi, India – 15th annual edition

Note: Provide up to 10 examples.

### 3.11.3 The most significant lectures by foreign scientists and other guests relevant to the R&D&I field at the evaluated unit during the 2014–2018 reporting period

Name, surname and title(s) of the lecturer	Lecturer's employer at the time of the lecture	Invitation lecture title
Prof. Viatcheslav FREGER	The Wolfson Department of Chemical Engineering, Technion – Israel Institute of Technology ( <a href="#">link</a> )	Opportunities in membrane technology for textile materials ( <a href="#">STRUTEX 2018</a> )
Dr. hab. Ing. Marcin BARBURSKI	Lodz University of Technology, Faculty of Material Technologies and Textile Design, Institute of Architecture of Textile ( <a href="#">link</a> )	Formation of the textile structures for a specified purpose ( <a href="#">STRUTEX 2018</a> )



Prof. Pierre OUAGNE	National Engineering School of Tarbes, France. Head of the composite, bio-composite and textile research centre ( <a href="#">link</a> )	From fibre extraction to the woven fabric manufacturing for reinforcing composites  ( <a href="#">STRUTEX 2018</a> )
Dr. Ing. Vincent PLACET	Department of Applied Mechanics – FEMTO-ST Institute, University of Franche-Comté ( <a href="#">link</a> )	Mechanics of biobased fibrous assemblies: from single fibre to composite material  ( <a href="#">STRUTEX 2016</a> )
Dr. Caroline SCHAUER	Department of Materials Science and Engineering  Drexel University, Philadelphia ( <a href="#">link</a> )	Electrospinning Natural and Synthetic Polyelectrolytes for Biomedical Applications ( <a href="#">The Fibres Society Spring 2014 Technical Conference</a> )
Dr. Arun Pal ANEJA	Department of Engineering, East Carolina University, NC, USA ( <a href="#">link</a> )	Squaring the Circular Economy: Textile Redesign ( <a href="#">9th Central European Conference 2017</a> )
Prof. Dr. Henry Yi LI	School of Materials, The University of Manchester ( <a href="#">link</a> )	Bioengineering Smart Functional Textiles ( <a href="#">9th Central European Conference 2017</a> )
Prof. Izabella KRUCINSKA, Ph.D.	College of Commodity Science, Lodz University of Technology ( <a href="#">link</a> )	The Review of the Technologies of Chemosensory Nonwoven Fabrics ( <a href="#">9th Central European Conference 2017</a> )
Prof. Ana Marija GRANCARIC, Ph.D., C.Col., FSDC	Faculty of Textile Technology, University of Zagreb ( <a href="#">link</a> )	Textile Sensors in Textile Reinforced Composites ( <a href="#">9th Central European Conference 2017</a> )
Prof. dr. ir. Lieva Van LANGENHOVE	Ghent University, Faculty of Engineering and Architecture, Department of Materials, Textiles and Chemical Engineering ( <a href="#">link</a> )	Intelligent Textiles  ( <a href="#">Autex study programme - E-Team NMSP "Textile Engineering" accredited in Gent, Belgium</a> ).

### 3.11.4 The most significant elected membership in foreign of professional societies relevant to the R&D&I field at the evaluated unit during the 2014–2018 reporting period

Name, surname and title(s) of the evaluated unit's member of staff	Name of professional society	Type of membership
Prof. Ing. Jiří MILITKÝ, CSc.	FEANI (European Federation of National Engineering Associations) is a federation of professional engineers that unites national engineering associations from 33 European Higher Education Area (EHEA) countries. ( <a href="#">link</a> )	President of Czech Monitoring Committee of FEANI Brussels
Prof. Ing. Jiří MILITKÝ, CSc.	Textile Bioengineering and Informatics Society ( <a href="#">link</a> )	Vice-Chairman of International Executive Committee
Prof. Ing. Luboš HES, DrSc., Dr.h.c.	International Measurement Confederation ( <a href="#">link</a> )	IMEKO TC12 (Temperature and Thermal Measurements) Member for Czech Republic
Doc. Ing. Michal VIK, Ph.D.	International Commission on Illumination ( <a href="#">link</a> )	Official division 1: Vision and colour member



Ing. Irena LENFELDOVÁ, Ph.D.	International Federation of Knitting Technologist ( <a href="#">link</a> )	National Sections of the International Federation of Knitting Technologists
Ing. Jiří HAVLÍČEK, CSc.	ATOK – Association of Textile-Clothing-Leather Industry	An administration board member ( <a href="#">link</a> )
Ing. Gabriela KRUPINCOVÁ, Ph.D.	CLUTEX – Technical textile cluster	Vice-president ( <a href="#">link</a> )
Prof. Dr. Ing. Zdeněk KŮS	An administration board member	ČTPT – Czech Technology Platform for Textile
Doc. Ing. Lukáš ČAPEK, Ph.D.	Czech Society for Biomechanics, z. s.	Vice-chairman of the Society for Biomechanics ( <a href="#">link</a> )
Ing. Pavla TĚŠINOVÁ, Ph.D.	AUTEX E-TEAM ( <a href="#">link</a> )	A member of the Accreditation Review Committee of the Autex joint study programme - E-Team follow-up Master's course "Textile Engineering"