ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

ROMANIAN TEXTILE INDUSTRY IN THE CONTEXT OF GREEN, DIGITAL AND SMART TRANSITIONS

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Abstract: *This paper presents aspects concerning digital, smart and green transition of the Romanian textile sector. This survey was conducted in the framework of the ADDTEX Erasmus+ project, between August and December 2022, involving mainly qualitative research methods (group activities and questionnaires, presenting concepts, meanings and perspectives) in the framework of the desk & field research and living lab sessions for ADDTEX Erasmus+ project. In order to conduct this survey several workshops were organized in situ or online (Meetup and living labs) concerning digital technologies to companies and HEI. In addition, we asked them to define their past, actual and future roles in the context of the green, smart and digital economy. Digitalization, integration of smart things and sustainable development are priorities for Romanian research and innovation sector and several initiatives such as implementing digitization, smart and green technologies and methods for innovative learning are ongoing. In addition, the main objectives including carbon footprint reduction and integrating digital and smart things (electronics) using IoT.*

Key words: *smart, digital economy, green, innovation, sustainability*

1. INTRODUCTION

INCDTP developed the analysis of the textile and leather sector in relation to the green, smart and digital technologies implemented in Romanian SMEs and universities in relation to:

-the main green, smart and digital technologies that can be applied to the textile and leather industry;

-the importance of implementing processes based on green, smart and digital technologies;

-Importance of implementing and disseminating the aspects of green, smart, digital knowledge;

-already implemented green, smart, digital technologies in textile companies; existing courses on green, smart and digital technologies;

-specific needs for companies and universities in the green, smart and digital economy; impact of COVID-19 in higher education institutions:

-rethinking of courses and online methods of control and transmission of information; impact of COVID-19 in SMEs:

-rethinking of production capacities, stocks and infrastructure for physical and online operations;

-Interest of Romanian SMEs and universities in participating in courses on the development of advanced smart/green/digital materials;

-Interest of Romanian SMEs and HEIs in participating in national and European learning, research and innovation projects.

Mainly qualitative research methods (group activities and questionnaires on open questions, concepts, meanings and perspectives) were used within the Desk & Field Research and Living Lab sessions. Within the workshops (Meetup and Living Labs) organized on-site or online, we presented to companies and universities the ADDTEX project objectives, main activities, expected results and benefits of green, smart and digital technologies. Furthermore, we asked them to define their past, current and future roles in the context of the green, smart and digital economy.

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

In the context of the green, digital and smart transition, several technologies/solutions have already been implemented by companies such as the use of recycling, waste management (selective collection of textile waste), energy from renewable resources (photovoltaic panels) and hybrid cars for product transport (Figure 1).

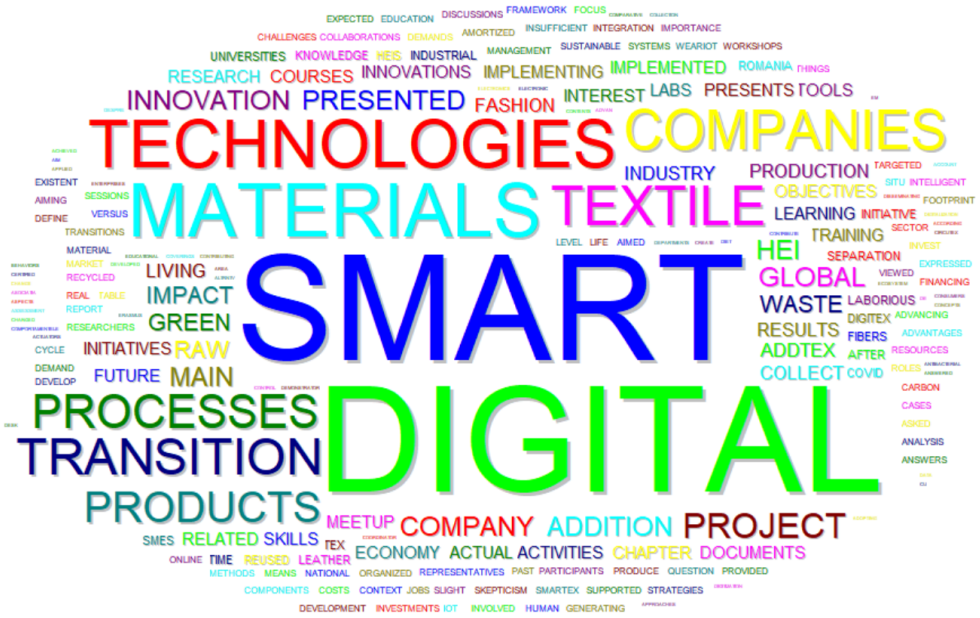

Fig. 1. Digital-Smart-Green transition based new technologies for advanced sustainable textiles

At the same time, companies already use fleet telematics systems based on GPS, video surveillance technologies of production lines, automatic cutting machines, access to databases with digitized patterns in the company, 3D design of shoe patterns and computer-aided design of patterns (e.g. , Lectra, Optitex, GERBER). In addition, the companies indicated that they use 3D design of shoe patterns, management, administration and production (ERP) programs and are interested in developing customized products (e.g., shoes for diabetics).

The invited companies believed that digital innovation would consist of automating the process of detecting defects in raw materials or products, using semi-automated workstations to manufacture military uniforms, using computer-aided design and 3D modeling, and the virtual

environment. Also, most companies believe that it is necessary to implement new ICT technologies to create innovative products with high added value and national and global demand.

In this context was performed a text data analysis using text mining techniques based on text link analysis, proximity distances analysis and terms frequency in text in order to observe the interest of the companies interviewed and who responded to questionnaires.

Text link analysis is based on a pattern matching technology that allows rules to be defined for patterns and to compare them with actually extracted concepts and relationships found in the analyzed text [1-3].

In this case, extracting ideas about digital, green and smart transitions in the textile sector through linkages between these concepts (smart, digital, green) and other terms (materials, textiles, advanced materials, pattern design and projects) can be interesting.

2. TEXT MINING ANALYSIS

The Text Link Analysis feature (Figure 2) enables the visualization of the connections between important words using a network diagram to explore the relationships and identify underlying patterns and structures of co-occurrences using three layout types: a multidimensional scaling, a force-based diagram, and a circular layout [1]. In Figure 2, the concept (terms) are represented as nodes, and the relationship between nodes is represented as a line connecting those nodes (also called an edge), with the thickness of this line representing the strength of that relationship [1-3].

Shown in Figure 3 is the proximity chart, which accurately displays the distance between objects by displaying the measured distance from a selected object to all other objects on a single axis. In this way, the information is extracted from the vast amount of data stored in the distance matrix at the origin of the multidimensional scaling plots. The distance from point 0 represents all distances. The 0 point indicates the lack of similarity or co-occurrence [4-5].

Table 1 presents the frequency of survey results indicating a significant frequency for digital, textile, smart and green terms [4].

Table 1: Principal words frequency

	Frequency	**Shown**	**Processed**	**Total**	**No. cases**	**Cases**	**TF • IDF**
DIGITAL	122	3.59%	1.86%	1.18%	2	100.00%	0.0
TEXTILE	110	3.24%	1.68%	1.06%	2	100.00%	0.0
SMART	108	3.18%	1.65%	1.04%	2	100.00%	0.0
GREEN	98	2.88%	1.49%	0.94%	2	100.00%	0.0
MATERIALS	92	2.71%	1.40%	0.89%	2	100.00%	0.0
TEXTILES	72	2.12%	1.10%	0.69%	2	100.00%	0.0
PROJECT	70	2.06%	1.07%	0.67%	2	100.00%	0.0
PRODUCTION	64	1.88%	0.98%	0.62%	2	100.00%	0.0

Text link analysis can be used to find relationships between different terms selected by respondents in a survey study [6-9].

By analysing the association strength between terms in Figure 2, it can be observed that the co-occurrence of the terms Smart and Digital Transitions and Smart Textiles/Learning represents a strong association of 0.408, and between Smart and Digital and Pattern Design has an association

strength of .408, respectively 0.405, meaning that respondents often associate the concept of smart/digital transition with technology-based CAD/CAM and virtual pattern design/modelling.

Furthermore, the association of smart/digital with smart textiles and learning stems from the fact that several initiatives involving universities promote e-learning methods on smart textiles.

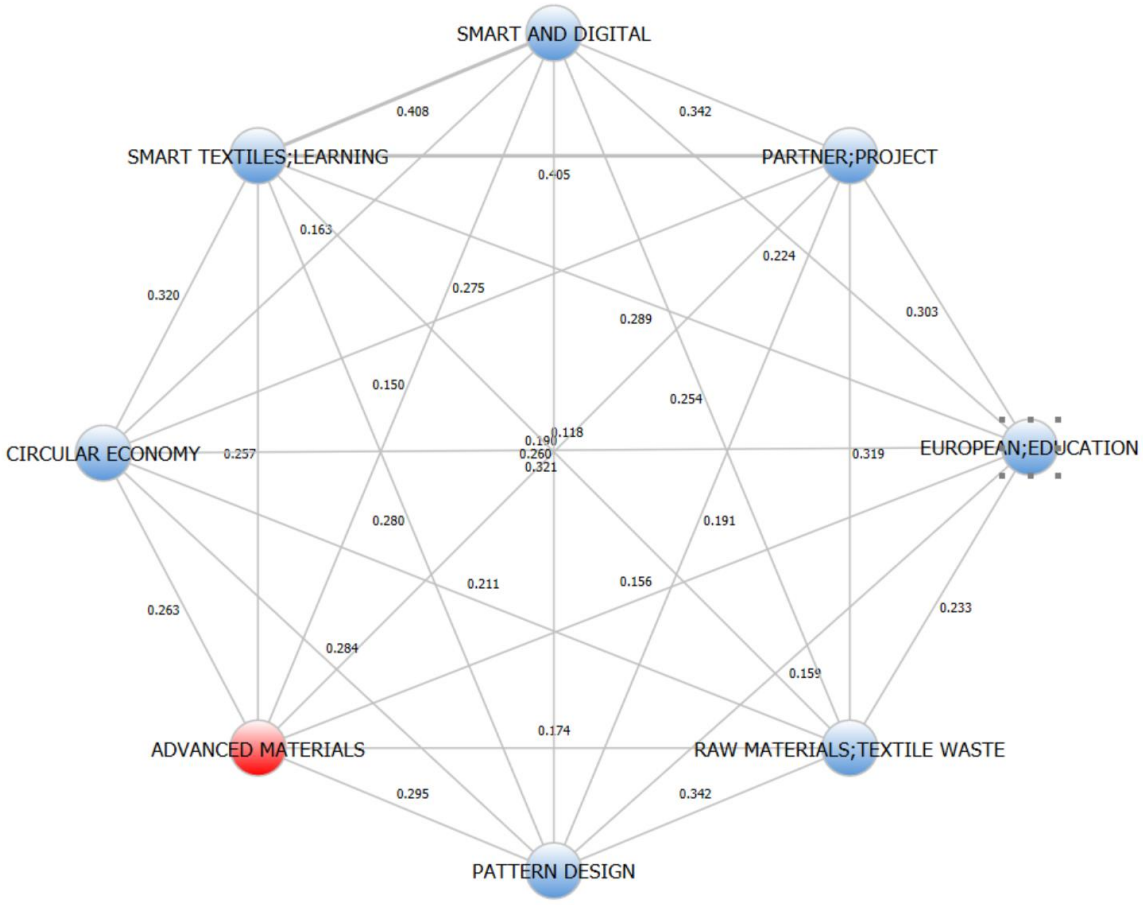

Fig. 2: Text link analysis

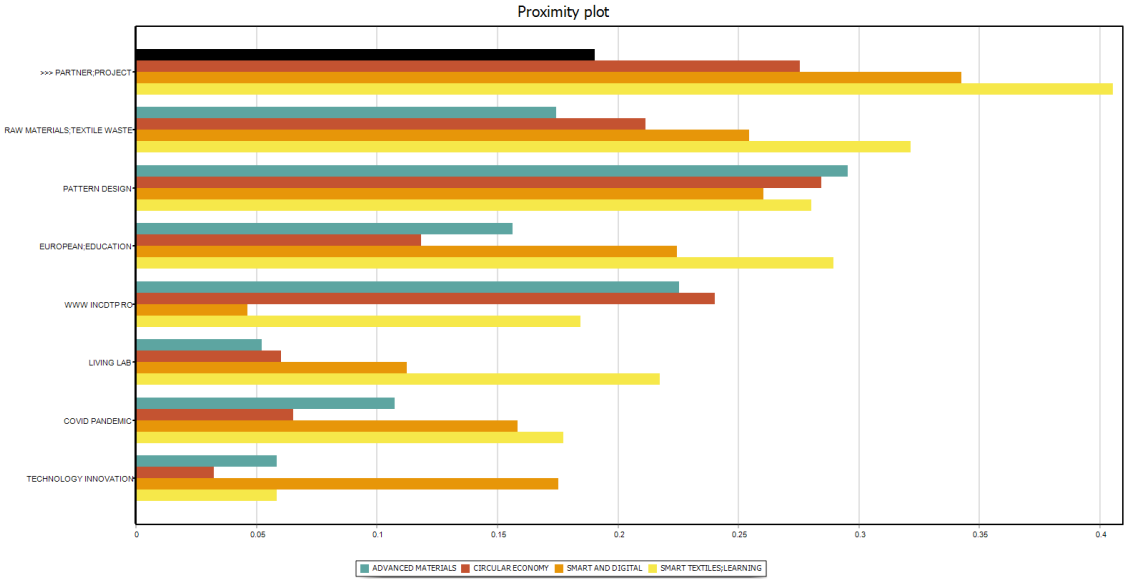

Fig. 3: Proximity plot

5. CONCLUSIONS

After the discussions in the Meeting Sessions/Living Labs with companies and universities about the goals and results of the ADDTEX project, the participants expressed a interest in courses and collaborations in new projects aimed at the smart, digital and green transition. Although for researchers and universities, this green-digital-intelligent transition is seen as generating new products, technologies, jobs and research or innovation projects, the company representatives indicated that these investments are made in new technologies or human resources to produce smart, advanced materials or the market requirements for these products must also support products. In some cases, they have viewed this transition with some skepticism, given the inadequate funding to the cost required for investments in means of production that would need to be recouped over time when there is a demand for those products. The meetings (Meetup and Living Labs) allowed the exchange of ideas and the adoption of common points of view, consisting of the need to improve the soft skills (writing of projects/patents, marketing analysis) of employees in companies and the development of new textile materials through the Employing groups of specialists for the co-design and co-creation of new materials and products, incorporating a multidisciplinary and interdisciplinary approach.

The companies were very enthusiast to add smart and digital technologies but not in the same way to introduce green transition because they considered important green transition for reducing the cost for energy through photovoltaic systems, but not through recycling textiles/waste and reusing for new products.

ACKNOWLEDGEMENTS

The Erasmus+ ADDTEX project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

The publication of the scientific paper is funded by the Ministry of Research, Innovation and Digitization within Program 1 - Development of the national R&D system, Subprogram 1.2 - Institutional Performance - RDI excellence funding projects, Contract no. 4 PFE/2021.

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