Texmatrix – The knowledge matrix for innovation applied to textile enterprises

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REZUMAT – ABSTRACT

Texmatrix – matrice a cunoștințelor pentru inovarea aplicată în întreprinderile de textile

Diferite instrumente de management al întreprinderii sunt utilizate pentru a sprijini inovarea. Matricea cunoașterii pentru inovare (KMI) cuantifică bunurile intangibile ale unei întreprinderi pentru a menține un inventar adecvat, a crea conexiuni și a elimina redundanțele. KMI a fost definită și pusă în aplicare pentru întreprinderile textile în cadrul proiectului Erasmus+ Texmatrix, pentru a răspunde nevoilor acestora de inovare: KMI a fost transformată într-un chestionar de benchmarking, un studiu de benchmarking a fost derulat cu implicarea unui număr de 64 întreprinderi textile europene, iar rapoarte pe plan european, național și la nivel de companie individuală au fost create pe baza rezultatelor obținute. Necesitățile întreprinderilor au fost extrase printr-o analiză SWOT a raportului european de benchmarking: 35 de soluții de proiecte au fost asociate celor șase principale Oportunități ale analizei SWOT. Aceste soluții de proiecte conțin rezultate în domenii precum: cercetare, piață sau instruire. Soluțiile, corelate cu trei module educaționale pentru sprijinirea inovării au fost implementate în cadrul unui curs de e-learning în cele cinci limbi europene ale parteneriatului: engleză, italiană, portugheză, română și slovenă. Cursul de e-learning Moodle conține diferite resurse (Carte, Video) și activități (Quiz, Glosar, Chat și Forum). Instruirea a fost realizată pentru un număr de 199 profesioniști din industria textilă în cadrul a 8 evenimente de multiplicare și pentru un număr de 137 tineri studenți în cadrul a 5 cursuri mixte. Profesioniștii din industria textilă și-au exprimat interesul pentru implementarea unor soluții de proiecte. Toate resursele educaționale create sunt disponibile cu acces liber pe platforma de e-learning a proiectului: www.advan2tex.eu/portal/.

Cuvinte-cheie: evaluare comparativă, raport, SWOT, soluții proiecte, e-learning

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Several enterprise management instruments are used to support innovation. The Knowledge Matrix for Innovation (KMI) quantifies intangible assets of an enterprise in order to keep an improved inventory, gap bridges and eliminate redundancies. The KMI was defined and implemented for textile enterprises within the Erasmus+ project TexMatrix, in order to respond to their innovation needs: the KMI was transformed to a Benchmarking questionnaire, a Benchmarking study was conducted with 64 European textile enterprises and Reports on European, national and individual enterprise level were created. The needs of the enterprises were drawn from a SWOT analysis of the European Benchmarking report: 35 project solutions provided by the consortium partners were assigned to six main Opportunities of SWOT analysis. These project solutions contain results in fields like: research, market and training. The solutions altogether with three educational modules for supporting innovation were implemented within an e-learning course in five European languages of the project's partners: English, Italian, Portuguese, Romanian and Slovenian. The Moodle e-learning course includes various resources (Book, Video) and activities (Quiz, Glossary, Chat and Forum).Training was performed for 199 textile professionals within 8 multiplier events and for 137 young students within 5 blended courses. Textile professionals expressed their interest in implementing some of the project solutions. All created Open Educational Resources are available with free access on the project's e-learning platform: www.advan2tex.eu/portal/.

Keywords: benchmarking, report, SWOT, project solutions, e-learning

INTRODUCTION

Several enterprise management instruments are used to support innovation [1]. They offer a simple and schematic modality to assess the potential risk and success of an innovation initiative [2]. Each instrument is dedicated to tackle a certain aspect of the enterprise's management. Some examples of management instrument meant to support innovation include:

a) Technology portfolio analysis;
b) Break-even point analysis;
c) Life cycle costing analysis;
d) Knowledge matrix for innovation.

Table 1 presents some basic aspects of these instruments.

The Knowledge Matrix for Innovation (KMI) quantifies intangible assets of an enterprise in order to develop an improved inventory, gap bridges and eliminate redundancies. Some examples of intangible assets include: training methodology, IP rights, innovation culture etc. It is called "matrix" for it quantifies the intangible assets on two dimensions: regarding their nature as an asset and their content [9]. The asset class envisages the form: book, magazine or database, while the content class envisages the meaning: market opportunities, threats etc.

Table 1

MANAGEMENT INSTRUMENTS AND THEIR USEFULNESS			
Instrument	**Problem tackled**	**Short description**	**Graphics & diagrams**
Technology portfolio analysis [3–4]	Systematic evaluation of new technologies and basis for strategic investment	Evaluates a new technology on two dimensions: attractiveness and resource strength	Technology Portfolio Technology atractiveness • Development potential • Application range • Compatibility Ressource strength • Technical-quality competitiveness • Potential • Reaction speed
Break-even point [5–6]	Product quantity at which turnover meets costs	Takes into account evolution of fixed and variable costs and of sale revenue per produced units	Turnover/product type — Sales, Total costs, Product quantity
Life cycle costing analysis [7–8]	Assessment of product's costs from idea up to withdrawal from the market	Incomes are neglected, while good saving of resources is performed by optimizing costs	Balance (Trade-off)
Knowledge matrix [9]	Classifies "pieces" of knowledge within a company	Divides existing knowledge in a company on assets and content classes	CONTENT CLASS: PRODUCT, PROCESS, PEOPLE, FRIENDS, FOES; ASSET CLASS: PROTECTED, PURCHASED, PRODUCED, PEOPLE

PROJECT'S OUTCOMES

The management instrument KMI was adapted to respond to the needs of textile enterprises, within the Erasmus+ project TexMatrix [10]. The project's logo is presented in figure 1.

Fig. 1. Erasmus+ and Project's logo [10]

Main aim in this regard was to be able to compare various intangible assets of textile enterprises from different European countries, based on a common quantification and to respond with project solutions to the identified needs. The KMI was defined and structured on Elements, Criteria and Factors. Elements include: Conditions, Resources, Activities and Results, which reflect the development of the enterprise. Criteria and Factors structure of KMI is given in figure 2.

No.	Element	Criteria	Factors
1.	CONDITIONS	Innovation culture	5
		Innovation strategy	5
		Leadership	4
		SUM =	14
2.	RESOURCES	Human resources	5
		Organizational structure	4
		Material resources	3
		External relationships	4
		Financial sources	1
		SUM =	17
3.	ACTIVITIES	Management of ideas	2
		Management of innovation projects portfolio	2
		Surveillance and knowledge management	3
		Innovation promotion	2
		IPR	3
		SUM =	12
4.	RESULTS	Evaluation and monitoring	5
		Image	3
		Learning from failures	1
		SUM =	9
		SUM =	52

Fig. 2. Structure of KMI [11]

The 52 Factors of KMI were transformed into a Questionnaire, meant to run a Benchmarking study with participation of 64 textile enterprises in partner countries: Romania, Italy, Portugal and Slovenia. The Benchmarking study revealed the relative position of a particular enterprise to the European and national mean values and led in consequence to deduction on innovation needs for these enterprises. The responses of enterprises were marked with a code in order to ensure confidentiality. Reports were created on European, national and individual enterprise level with valuable results on innovation state-of-the-art in textiles. Figures 3–6 show some diagrams for the European and Romanian national Benchmarking report.

The Benchmarking report on European level includes the profiles of enterprises interviewed (most (57.1%) operate in clothing/fashion, followed by technical fabrics (41.3%)), the number of employees (24% large enterprises, 30% medium enterprises, 24% small enterprises, 22% micro enterprises), turnover, investment in innovation activities (figure 3). The Knowledge matrix criteria were subsequently assessed in detail. As an example, innovation culture was assessed on Likert scale (0–5; 0 = Lowest, 5 = Highest grade) for following factors:
– Innovation is one of the company's values;
– Promotion of innovation initiatives;
– Mechanism for technological surveillance;
– Encouragement of continuous change.

Figure 4 shows that factor "Innovation is one of the company's values" reached grade 4 on Likert scale with 32%, which means textile enterprises focus relatively high on this Innovation culture factor. As another example in relation to training methodology, criteria Human resources was assessed on following factors:
– The company has an HR policy which encourages innovation
– The company has a training policy that promotes innovation;
– Employees are team players when it comes to innovation;
– There are employees with adequate technical skills to perform R&D/innovation activities.

Figure 5 shows that factor "Employees are team players" reached grade 4 with 27% and factor "Employees with adequate technical skills" reached grade 4 with 22%, which means enterprises focus more on these two factors. On the other hand, Human resources and Training policy were mainly pointed out with grade 3, showing relatively less interest for enterprises.

Moreover, the Benchmarking reports on national level included diagram with relative situation of the enterprises from one partner country to the European mean. Figure 6 shows types of training activities organized by the enterprise for its personnel, with following factors:
– Technical training;
– Management training;
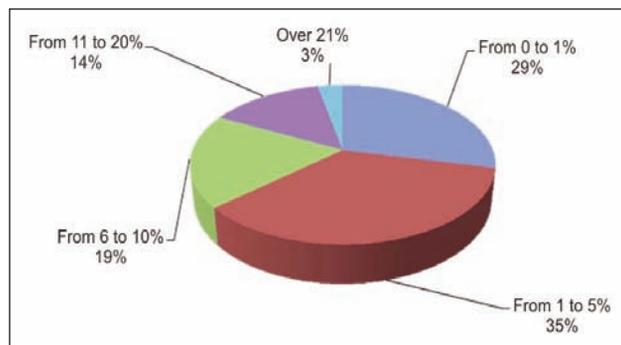– Traditional training (i.e.: lessons by a teacher on a classroom);

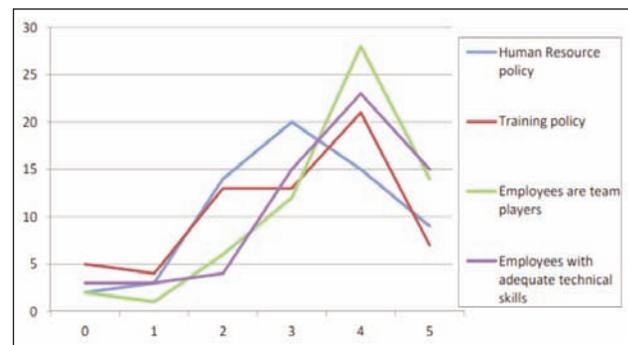Fig. 3. Investment in innovation activities in percent of the questioned enterprises [11]

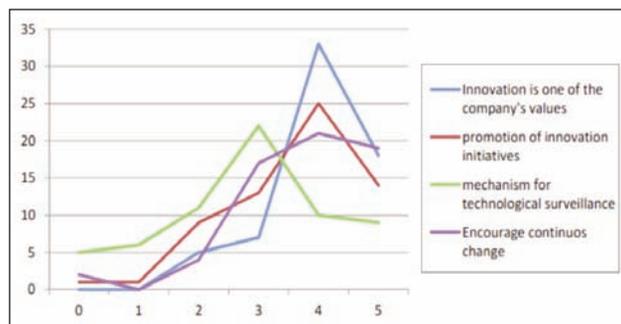Fig. 5. Human resources policy on Likert scale for several indicators [11]

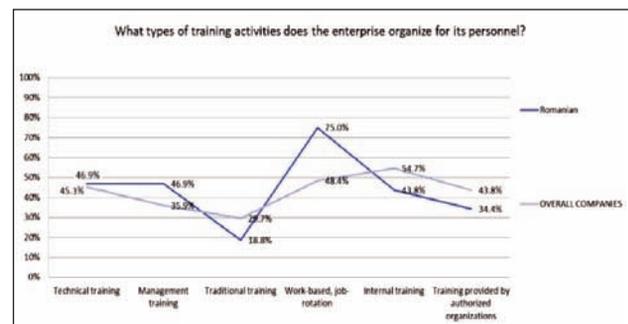Fig. 4. Innovation culture on Likert scale for several indicators [11]

Fig. 6. Training activities with relative situation of enterprises on Romanian and EU level [11]

– Work-based, training on the job, job-rotation or e-learning;
– Internal training;
– Training provided by authorized organizations.

The question had multiple answer possible (checkboxes) and was assessed in percent. Figure 6 shows Romanian enterprises chose with 75% work-based job rotation as main training modality of employees, when compared to only 48.4% on EU level. Other statistical data on the interviewed enterprises may be found within the reports on European and national level, implemented as Open Educational Resources (OER) on the project's e-learning platform www.advan2tex.eu/portal/.

A SWOT analysis was performed on the Benchmarking report on European level, having the main purpose to evidence the needs of textile enterprises and especially to valorize the Opportunities. Six relevant Opportunities were selected to leverage innovation for enterprises with support of the research providers:
• New markets opportunities;
• Advances in technology;
• Textile products with higher added value;
• Emerging IT;
• Design of textile products.

Employees are team players (educational project solutions).

The five consortium partners are research providers in textiles with a long-lasting experience in their countries and numerous research results. Relevant project solutions were selected to match the identified Opportunities of SWOT analysis. The connection between project solution and SWOT Opportunities was created within a cluster table (print-screen). 35 project solutions on types such as: Research, Training and Market were included in the cluster table (table 2) [11].

A one page description with pictures and diagrams for each project solution was provided by each partner and comprised in a Guide with new solutions. Examples of solutions include technical textiles for fireproofing, medical sanogenetic bandages, monitoring devices, nets for agriculture, electromagnetic flexible shields, or improved yarns and fibers as well as new finishing or dyeing methods. Market solutions include open innovation platforms for project's matchmaking. Training solutions include e-learning platforms with various Open Educational Resources in textile and related fields. All these 35 project solutions are implemented as e-learning content with free Guest access in the TexMatrix course on www.advan2tex.eu/portal/.

Three modules for supporting knowledge on innovation both for textile professionals and young trainees were provided by the project's partners:
• Elements specific to innovation;
• Instruments for supporting and promoting innovation;
• Legislative framework for protecting innovation.

These three modules were implemented on the project's e-learning platform as OER, too.

E-LEARNING SOLUTION

The Guide with 35 project solutions and the three modules on innovation were translated in four partner's national languages: Italian, Portuguese, Romanian and Slovenian. Based on the presented educational materials a Moodle e-learning course was designed for four partner's national languages plus English. The Moodle e-learning platform is multi-lingual. One e-learning course includes first of all communications instruments for tutoring between teachers and trainees: Chat for synchronous communication and Forum for asynchronous communication were implemented as Moodle activities. Permanent consulting between teachers and trainees is important for a good learning process. Secondly, all three modules on innovation were implemented as Moodle Book resources with navigation buttons and table of contents, including graphs, diagrams and pictures. All 35 project solutions were implemented as Glossary activity for a certain reason: this allows the user to access these solutions as logical content, based on hyperlinks auto-linking and as sequential content, based on alphabetic indexing [12]. Multiple choice tests were implemented as Quiz activities for each module of the Guide. Moreover, Youtube videos with interviews with national coordinators on project's impact were included for a more real touch within the e-learning course. Figure 7 presents a print screen of the English e-learning course.

Table 2

ADVANCES IN TECHNOLOGY			
Partner	**Project title**	**Sector**	**Project type**
INCDTP	MULTITEXFUNCTION – Innovative production chain for textile by plasma nanotechnology	Technical textiles	Research
CENTROCOT	LIFE Prefer – Product Environmental Footprint Enhanced by Regions	Other	Research
UM	FLARETEX – Sustainable flame retardancy for textiles and related materials based on nanoparticles substituting conventional chemicals – COST Action MP1105	Technical textiles	Research

Fig. 7. Print screen of the project's e-learning platform [11]

Fig. 8. Multiplier event at University of Maribor

Fig. 9. Blended curse at TecMinho

PROJECT'S IMPACT

The created Open Educational Resources were provided to the target group of professionals from the textile industry and to young trainees in textiles within multiplier events and blended courses. The multiplier events were organized for multiplying the four intellectual outputs of the project (Knowledge Matrix for Innovation, Benchmarking study, Guide with new solutions and E-learning tool) to relevant stakeholders from textile enterprises: decision-making staff, HR specialists and professionals. Main aim was to present the 35 project solutions as well as results from the Benchmarking reports and to attract young trainees for the blended courses. The blended courses had as target group: young employees, textile students and scholars and young unemployed workforce. Blended courses mean both classroom and e-learning courses. The program was scheduled for five days: one or two days for classroom learning and e-learning platform training and three to four days for e-learning and self-assessment on www.advan2tex. eu/portal/. Main educational topics were the three modules on innovation, the project solutions as means to promote innovation and aspects related to the Benchmarking reports and Knowledge matrix. An important topic was the use of the e-learning platform itself, with authentication, navigation through the courses and possibility to access the multiple choice tests.

Eight multiplier events were organized by the project's partners with participation of 199 professionals in textiles, instead of 100 initially foreseen. INCDTP-Bucharest organized three events, two at its headquarters and one at the textile cluster Transylvania Textile&Fashion in Sf. Gheorghe, Romania, altogether with 84 participants. Centrocot organized two workshops, while other partners, such as the Technical University from Iasi organized one workshop with 50 participants. The impact of the project's intellectual outputs was corresponding high and many stakeholders expressed their interest in the project solutions. The conclusions drawn from Benchmarking reports and the modules on innovation could substantially support the participants on

key points for improving innovation within their enterprises.

Five blended courses were organized with 137 young trainees, instead of 95 initially foreseen. A substantial number of trainees could be attracted by HR specialists and decision makers participating previously at multiplier events. Main attraction was using modality of the e-learning platform, the open innovation concept and the new innovation archetypes of the module prepared by Centrocot. The tutors provided special care for the trainees to complete self-assessment tests. Figures 8 and 9 present the activities at one of the Multiplier events and one of the Blended courses. Great impact was ensured on consortium level, while added-value on European level could be achieved by the relative situation of national enterprises compared to mean European values (benchmarking reports) and the exchange of project solutions – some of the partner's solutions were received with great interest by the addressed stakeholders.

CONCLUSIONS

The Erasmus+ project "Matrix of knowledge and competitiveness for textile enterprises" had an innovative concept, for the four intellectual outputs were built one on the top of the other – based on an enterprise management instrument. The Knowledge matrix was defined, the Benchmarking questionnaire created and the Benchmarking study accomplished,

SWOT analysis was applied to the benchmarking report in order to highlight Opportunities, which were associated with project solutions and modules on innovation by the project partners. Moreover, an innovative Moodle e-learning course presented the solutions as logical content – provided by the project concept and as sequential content – with alphabetic indexing. The e-learning course was prepared in five European languages (English, Italian, Portuguese, Romanian and Slovenian) and included multiple choice tests in each module, Youtube videos with interviews and various communication instruments between tutors and trainees. The impact of the project's outcomes was especially high within the organized multiplier events and blended courses. Various target groups of textile professionals and trainees were successfully addressed.

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