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Future of the Polish Textile Industrial Sector. An Overall Analysis of the Empirical Research Performed with the Delphi Method within the Project Foresight 'Modern Technologies for the Textile Industry. A Chance for Poland'

Abstract

The article presents the initial discussion of the results of research performed with a Delphi method within the project Foresight 'Modern technologies for the textile industry. A chance for Poland'. This project was done as a part of the POIG (Operational Programme Innovative Economy) for the years 2007-2013. It was aimed at identifying the directions of scientific researches and developmental works in the range of preparing a strategy for the Polish Technological Platform of the Textile Industry. The intention of the projects of the Foresight type is to direct scientific researches to fields which in the future can have a high influence on the fast economic-industrial development of a country, leading to the development of a knowledge-based economy, in accordance with the Lisbon Strategy.

Key words: Polish textile industry, Foresight, Delphi method, modern technologies.

opment of a social, and not only a strictly scientific vision of the future has become crucial. It appears that the biggest role in this context is played by technological foresight programs (whose origins go back even to the 1970s'), integrating traditional methods of forecasting as well as those derived from the social sciences, economics, management science, etc.[1]. In the literature we can find a lot of definitions of foresight, most of which point out a few important aspects:

- *Foresight* is not only foreseeing or **predicting** the future but also managing and **creating it**, influencing the course of events [2, 4 - 6].
- It is a **systematic**, participatory, future-intelligence-gathering, medium-to-long-term vision-building process [3, 6 - 8].
- Looking into the longer-term future, it helps decision-making and addresses questions related to the relationship between **science, technology, economy and society** [7, 9, 10].

The European *Foresight* Monitoring Network and the European Foresight team of the Knowledge for Growth looks on foresight as on a triangle combining "Thinking the Future", "Debating the Future" and "Shaping the Future" [3, 11].

The first document giving grounds for the idea of foresight development in Poland was the Ordinance of the government Minister of Science and Information No. 7/2004 of 3rd March 2004 on

the establishment of a Steering Committee for the Pilot Foresight Project in the field of „Health and Life” [4, 12]. The next step was the launch by the Minister of Science and Higher Education, of the National Foresight Program 'Poland 2020' in December 2006 [13]. In 2010, actions within the textile industry were also undertaken, the effect of which is *Foresight 'Modern technologies for the textile industry. A chance for Poland'*, which is the subject of the current article.

Assessment of the position of Poland in the European textile-clothing industry

According to the results of the International Ranking, Poland is currently placed 41 in the world with respect to competitiveness according to the indicators [19]. It is viewed as a country which is only heading to the group of leaders, being an indicator of innovativeness, in which our country is placed 23rd among the 27 member countries of the EU, separating us from this group [20].

A change in this situation requires the growth of innovativeness, as a basic factor of the improvement of competitiveness. It can be achieved only by increasing funding for R&D (research and development) and for the commercialisation of technologies developed.

In an updated Review of the European Commission concerning the importance

Introduction – Foresight as an instrument of shaping the future of the Polish textile-clothing industry

Since the end of the twentieth century there has occurred a noticeable worldwide paradigm shift in studies of the future, which so far have been based mainly on statistical methods. The devel-

of European industry in the changing world [21], a diagnosis of the situation in 32 sectors of European industry and service sectors is presented.

The fashion and design industries provide, admittedly, about 8% of the European added-value in industrial processing, but they are still characterised by a relatively low pace of economic growth.

Among the sectors of industry mentioned, in the diagnosis of the state and external competitive position of the sectors examined with respect to partners and competitors from the Non-EU countries, the importance of Poland was recorded, inter alia, in the sector of the production of textiles and clothing, in which Poland occupies a considerable and growing position in Europe, next to Bulgaria, Greece, Austria and Italy, while the position of France, UK and Ireland is diminishing [22].

In the context of predictions resulting from research performed within the *National Foresight Programme – Poland 2020*, it should be emphasised that the textile industry, based on innovative material technologies, belongs to the main developmental engines of the Polish economy [13, 23].

In the research performed with the Delphi method within the Project *Foresight ‘Modern technologies for the textile industry. A chance for Poland’*, it was assumed that the basic criterium for evaluation of hypotheses concerning the technologies examined would be the chance that they created for obtaining a significant competitive position on the international market in the near or distant future.

It is, therefore, justified to invest in those technologies that can become competitive not only on the national market but mainly on the international market in the age of the globalisation of the economy and significant lowering of customs and external-customs barriers in international trade, and especially with their complete abolition on the European market for member countries of the EU.

In the textile-clothing industry, we have observed in recent times deep technological changes that have revolutionised its outlook. This industry is gradually becoming a world leader in utilising technologies, technical-technological, product and organisational innovations,

especially in the area of technical fabrics, thanks to which it is entering areas that have been so far reserved for high-technology industries. These changes are also taken into consideration in the strategies for the development of light industry, showing crucial areas for the competitiveness of companies, but also showing problems that remain to be solved in them. The goal of the aforementioned Foresight project was, inter alia, the rational planning of actions aimed at solving those problems in Poland. This article presents the results of research of one of the stages of that project, namely the Delphi Rounds. The method of Delphi Rounds enables to create long-term visions of the future and constitutes a form of long-distance group discussion. It is based on asking selected experts about their opinions on a given topic several times. In the project described two Delphi Rounds were performed, which enabled to organise the data selected and to process the opinions of the experts according to the designated aim of the research [14 - 17].

■ Methodology of research

The aim of the Delphi Rounds was to assess the probability of the implementation/consumerisation of critical textile technologies that were determined during the earlier stages of the Foresight project, as a starting point for the strategic programme of research and assumptions for innovative policy. Two methods were selected as the most adequate for the realisation of this goal [18]:

1. Policy Delphi – form of electronic survey performed with the use of a specially prepared platform. Basing on an iterative exchange of information, it is a form of structured communication process amongst a group of anonymous persons/experts possessing certain knowledge and representing different options (scientific employees, managers and technologists employed in companies, employees of administration, consulting companies, banks, social partners). In the case of research performed within the project described *Foresight ‘Modern technologies for the textile industry. A chance for Poland’*, 233 experts have answered to the questionnaires prepared.
2. Delphi conference – form of stimulating workshops. Its aim was to broaden the discussion about the probability of implementation/consumerisation of

critical textile technologies, with the directions of public intervention (philosophy and instruments of support).

Assumptions

It was assumed that the basic criterion for the evaluation would be the **competitive position on the international market**, as it is justified to invest in those technologies that can become competitive on the international market. The analysis was performed for three areas:

- **Area I: Textile raw materials**
- **Area II: Textile technologies**
- **Area III: Technologies of applied, technical and special products**

The analysis was performed in four stages:

Stage I of the analysis involved the assessment of the **current and future international competitive position** of Poland for particular technologies (the technologies were evaluated on a **1-9 scale**, where **1** was far behind the leader, and **9** far ahead).

Stage II of the analysis involved the **period of time predicted** for achieving a competitive position of the leader.

Stage III of the analysis involved the evaluation of **scientific-research and absorption potentials of the economy** and the **quality of the environment**. In this stage only those hypotheses were evaluated that were assessed by the experts as being able to achieve a high competitive position in the future (grades 4.5 to 9) during Stage I.

Stage IV – prioritisation of hypotheses/types of technologies.

After Stage I the technologies that were assessed by the experts as those that will have the highest difficulties in achieving a future competitive position were not taken into consideration in further stages of the analysis.

■ Results of research

After performing the analyses within 4 stages, as described in the aforementioned methodology of research, the critical technologies determined within the earlier stages of the project Foresight were classified in four categories according to their predicted future competitive position as well as scientific-research potential, absorption potential of the economy and institutional potential.

The four categories were:

- **Category I:** the group of very strong technologies with the best current potential and predicted future competitive position.
- **Category II:** the group of strong technologies with fairly weaker current potential, but equally strong future competitive position.
- **Category III:** the group of technologies that has very good current potential, but lower than average future competitive position.
- **Category IV:** the group of fairly weaker technologies that were assessed by the experts as those that have the weakest potential and lower possible future competitive position.

The technologies from each of the three areas that were subject to analysis, classified in the categories described above, are presented in *Tables 1, 2 and 3* for each of the three areas, respectively.

Primary factors for development of scenarios

After the analyses of the results of research of the Delphi Rounds, an analysis of possible future scenarios for the textile industry in Poland was also performed. The 2 scenarios developed are presented below.

Scenario 1. Optimistic

Factors supporting the development of textile technologies in the coming years

- Together with the realisation of the first goal of the European Union Strategy EUROPA 2020, finances for the development of modern technologies will increase within the structural funds of the EU obtained by Poland for the years 2014 - 2020;
- Financing from the new EU structural funds may contribute to the development of new textile technologies in Poland in the context of the growth of demand for them in Europe and in many countries outside Europe (this concerns mainly the most advanced technologies from Area III - Technologies of applied, technical and special products);
- Together with the growth of the share of highly-educated people in the overall number of citizens there will be an increase in both the quantity and quality of intellectual capital in Poland, as well as in innovativeness due to the modernisation of the educational system;

- Commitment to the quantity and quality of human resources employed in scientific-research units in the sector of new textile technologies will take place.
- Further development of a scientific-research infrastructure will occur.
- There will be greater openness of science to the needs of the economy, whose absorption potential will improve due to cooperation with units from the science sectors and business environment;
- The quantity of grants both from European funds and from the resources of national funds for the needs of financing new technologies from textile and clothing industries will increase;
- The institutional potential of the economy with reference to the quality of the environment will improve;
- The marketing competencies of personnel in the range of the promotion of new textile technologies will improve;
- The economic atmosphere promoting the development of technology will be maintained;
- Interest in own brand building strategy and its influence on the competitiveness of the company will increase;
- Better utilisation of electronic commerce as a tool contributing to increasing the market activity of companies will occur;
- Awareness among the personnel of companies about the relationship between the increase in innovativeness and a chance for the internationalisation of the company through the development of imports and exports, as well as setting up branches abroad will improve;
- Thanks to the aforementioned actions the technological gap will decrease by strengthening education in the field of technical sciences and better internationalisation of this sector;
- More effective actions will be undertaken from the side of companies to create clusters, thus creating networks of connections between the areas of science and companies;
- More effective utilisation of EU structural funds will occur, which should contribute to increasing the technological level, including clean and pro-ecological technologies and to increase the innovativeness of companies (by creating and implementing new technologies), which is the main factor for improving their competitiveness [13].

Scenario 2. Pessimistic

Potential threats – main factors that can weaken the technological development of textile technologies in the medium and long term in Poland

- Lack of effective reforms of the higher education system in Poland leading to achieving a high quality of education and to financing pro-developmental scientific researches in directions oriented towards creating and implementing new technologies fostering processes of creating innovations can escalate the phenomenon of deterioration in the quality of intellectual capital in Poland and of the brain drain, and also weaken the already fairly weak economic innovativeness. In such a case, the low increase in salaries and incomes of Poles, based mainly on depleting reserves of economic growth resulting from the decreasing resources of the cheap labour force (instead of on the ability of human capital to create innovations and technologies – as for intensive development factors) could become a weakening factor for economic growth, or even become its stumbling block (depending on the level of activity of neighbouring countries of Poland in competing for the inflow of foreign investments and educated (and relatively cheap) employees);
- Lack of political courage and social support for the realisation of the most important reforms of the public sector can cause, in conditions of an ageing population, that a deficit of financial resources and labour force will appear, intensified by the lack of utilisation of potential employees with high professional experience capable and willing to work to the age 55+, which can be deepened by the emigration of young educated citizens in the age of full access to the European labour market;
- The development of bureaucracy and corruption can cause that low paid administration office workers will create obstacles for the development of entrepreneurship, inventiveness and social creativity;
- Too slow structural changes (including a low-pace decrease in the significance of production branches with extremely low labour costs and so-called 'dirty' production branches, as well as the transferring of such production from Western Europe) and limited resources cause the inhibition of striving towards the higher technological level

Table 1. Results of the prioritisation of hypotheses/types of technologies within Area I: Textile raw materials.

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| <p>Category I: the group of very strong technologies with the best current potential and predicted future competitive position.</p> | <p>Category II: the group of strong technologies with fairly weaker current potential, but equally strong future competitive position.</p> |
| <p>H6. Nanotechnologies will be used in processes of enriching natural fibres in order to give them multifunctional properties H29. Electronic commerce has a very high influence on performing economic activity in Area I: Textile raw materials, due to higher and higher technological development, lowering costs of access to the internet and broader possibilities of ensuring good customer service</p> | <p>H1. Technologies of modification of bast fibres (enzymatic, chemical, mechanical, physical - with the use of plasma, osmosis, and others) give the possibility of shaping properties of fibres, ensuring the possibility of their multi-directional utilisation H13. The development of fibrous materials for special applications on the basis of biocellulose will occur (the microbial cellulose) – a biotechnological method of manufacturing cellulose fibres H25. Future needs of the economy create a strong increase in demand for engineering professions connected with innovative textile industry H28. For customers from Area I: An important factor of textile raw materials in Poland when deciding about the selection of a given brand/producer is its social responsibility – caring about the environment (certificates), caring about quality, cooperation with local authorities, caring about employees – trainings, salaries, vacations, work safety norms, etc.</p> |
| <p>Category III: the group of technologies that has very good current potential, but a lower than average future competitive position.</p> | <p>Category IV: the group of fairly weaker technologies, that were assessed by the experts as those that have the weakest potential and lower possible future competitive position.</p> |
| <p>H19. An acceleration of the development of biodegradable fibres based on renewable raw materials will occur (including those from polylactic acid) H20. Further development of technologies of polyethylene fibres for technical use is predicted, especially those from polypropylene H26. Increase of innovativeness fosters the development of the internationalisation process of companies by the development of imports and exports, and by setting up branches and subsidiaries abroad</p> | <p>H27. In the case of Area I: Textile raw materials, an important factor of competitive advantage is the ability to carry out the policy of responsible purchases and based on that build a 'responsible' supply chain (selection of suppliers and business partners based on high ethical, ecological and quality standards) H4. Whitening and modification of cotton fibres will be based on utilising biotechnological methods</p> |

Table 2. Results of prioritisation of hypotheses/types of technologies within Area II: Textile technologies.

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| <p>Category I: the group of very strong technologies with the best current potential and predicted future competitive position.</p> | <p>Category II: the group of strong technologies with fairly weaker current potential, but equally strong future competitive position.</p> |
| <p>H6. The technology of needle-punched nonwovens enables the manufacturing of a wide assortment of products intended for different branches of economy H9. Melt-blown nonwovens have the broadest utilisation in the area of filtering and absorption nonwovens H11. Biotechnologies support traditional technologies of textile products' finishing H13. In finishing technologies an important role is played by antibacterial finishing H15. An important role is played by the functionalisation of textile products, aiming to give special features to those products (water-proofness, non-flammability and hard flammability, dust-proofness, barrierity to UV radiation), among others H19. The technology of manufacturing semi-fitted and fitted knitted fabrics constitutes a leading technology of manufacturing knitted products H20. Technologies of taken, relief, jacquard and openwork knitted fabrics create the possibility of getting attractive products with a rich design H33. Electronic commerce has a very high influence on the performance of economic activity in Area II: Textile technologies, due to higher and higher technological development, lowering costs of access to the internet and broader possibilities of ensuring good customer service</p> | <p>H1. Technologies of fabrics improving the comfort of usage are commonly used for creating systems ensuring full accommodation of the user to changing conditions of the life environment H12. Nanotechnology enables to obtain new, attractive products with special features H14. The technology of finishing textronic materials conforms very well to the vision of the development of the textile industry H21. Knitting technology enables to manufacture flat and 3-dimensional implants H25. Technologies of functional materials with the utilisation of expanded spatial structures of knitted fabrics are used in the production of sports, rehabilitative-medical and screening products H29. Future needs of the economy create a strong increase in demand for engineering professions connected with innovative textile industry</p> |
| <p>Category III: the group of technologies that has very good current potential, but lower than average future competitive position.</p> | <p>Category IV: the group of fairly weaker technologies that were assessed by the experts as those that have the weakest potential and lower possible future competitive position.</p> |
| <p>H7. In the production of nonwovens the most preferred are the technologies of manufacturing fibrous materials directly from molten polymer H27. Nano- and biotechnologies in the leather and shoe industries give the possibility of manufacturing products with the highest quality and barrier properties H30. An increase in innovativeness fosters the development of the internationalisation process of companies through the development of imports and exports as well as the setting up of branches and subsidiaries abroad</p> | <p>H2. Textronic clothes will be commonly used in everyday life H8. There are nonwovens manufactured with the electrospinning method intended for absolute filters and medical products H10. The technology of composite nonwovens of the melt-blown and spun-bonded type creates a possibility of obtaining innovative technical products H23. The technologies of multifunctional products and intermediate products of modelled shape in ecologic techniques minimise textile wastes H24. Technologies of the future in the area of textile materials directed to lowering the surface mass of the product with particular consideration of special applications H28. Building brand strategy among companies from Area II: Textile technologies will positively influence the competitiveness of the company H32. For customers from Area II: For textile technologies in Poland, an important factor of textile raw materials when deciding about the selection of a given brand/producer is its social responsibility – caring about the environment (certificates), caring about quality, cooperation with local authorities, caring about employees – training, salaries, vacations, work safety norms, etc.</p> |

Table 3. Results of prioritisation of hypotheses/types of technologies within Area III: Technologies of applied, technical and special products.

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| <p>Category I: the group of very strong technologies with the best current potential and predicted future competitive position.</p> | <p>Category II: the group of strong technologies with fairly weaker current potential, but equally strong future competitive position.</p> |
| <p>H32. Electronic commerce has a very high influence on the performance of economic activity in Area III: Technologies of applied, technical and special products, due to higher and higher technological development, lowering costs of access to the internet and broader possibilities of ensuring good customer service</p> <p>H17. Knitting technologies are widely used in the range of utilising them for the construction of safe toys</p> <p>H22. In the technology of finishing accessories in construction textile substrates eliminating classical structures of composite products are used</p> <p>H27. Among the companies from the market of the Area III: For technologies of applied, technical and special products, the utilisation of technologies allowing to differentiate the features of products to the individual need of a client is common</p> <p>H18. Geo-composites find broader and broader usage as strengthening, drain, filtering and separative products in the construction of communication roads and earthen structures</p> <p>H16. Due to requirements connected with the protection of the environment and assumptions of sustainable development, utilisation in the environment protection of textile filtration materials based on innovative material and technological solutions is common</p> | <p>H31. For customers from Area III: For technologies of applied, technical and special products in Poland an important factor deciding about the selection of a given brand/producer is its social responsibility – caring about the environment (certificates), caring about quality, cooperation with local authorities, caring about an employee – training, salaries, vacations, work safety norms, etc.</p> <p>H14. The utilisation on an industrial scale of virtual design technologies with the use of 3D posture scanning, cutting and construction of clothes, and fitting to posture with the use of virtual technique is common</p> <p>H28. Future needs of the economy create a strong increase in demand for engineering professions connected with innovative textile industry</p> <p>H30. In the case of Area III: : For technologies of applied, technical and special products, an important factor of competitive advantage is the ability to carry out the policy of responsible purchases and based on that build a 'responsible' supply chain (selection of suppliers and business partners based on high ethical, ecological and quality standards)</p> <p>H23. An important role is played by textile upholstery, construction, insulation and filtration products in textiles used for equipping interiors and home appliances</p> |
| <p>Category III: the group of technologies that has very good current potential, but lower than average future competitive position.</p> | <p>Category IV: the group of fairly weaker technologies that were assessed by the experts as those that have the weakest potential and lower possible future competitive position.</p> |
| <p>H19. Due to the requirements connected with environmental protection in the technology of nonwoven materials for utilisation in hygienic, medical and protective products, biodegradable raw materials are commonly used</p> <p>H21. Textile materials for filtration of liquid sprays and fluids have substantial application in car industry</p> <p>H24. Textile materials that are 'warp' for manufacturing light, easy-to-assemble and disassemble construction elements are produced on a big scale</p> <p>H25. In the range of textile protective products modern technologies that actively absorb the energy of impact are commonly used</p> | <p>H26. Building brand strategy among the companies from Area III: Technologies of applied, technical and special products will positively influence the competitiveness of the company</p> <p>H15. Utilisation of direct clothes forming is common on an industrial scale</p> <p>H4. In the construction of anti-electrostatic clothes it is common to use textile materials from core yarns and those with metal particle surface coating</p> <p>H9. Technologies of bio-active resorbable wound dressings are most often used in clinical and consumer applications</p> <p>H1. For the production of products of special purpose (measures of individual protection and uniformed products), technologies of laminates with nano-fibres and nano-additives are commonly used</p> <p>H29. An increase in innovativeness fosters the development of the internationalisation process of companies through the development of imports and exports as well as the setting up of branches and subsidiaries abroad</p> <p>H7. Technologies of the integration of textronics with clothing textile products are generally available and used in a wide range of applications</p> <p>H13. Technologies of biological substitutes used as matrices for tissue culture displaced from the clinical application standard, invasive reconstruction procedures</p> |

of Poland and to 'cleaner' and more ecological technologies.

Overall conclusions resulting from research within the Delphi Rounds

- There is a dominant positive assessment of the experts that the majority of the technologies investigated will achieve a competitive position on international markets in the period 2020 - 2025;
- The most advanced technologies from Area III (Technologies of applied, technical and special products) are still characterised, at the current stage of economic development in Poland, by relatively low competitiveness on the national and international markets, which is indicated by the low

absorption capability of the economy, resulting from relatively low interest in (demand for) these technologies. Their further development is necessary, however, with their implementation depending on significant financial help for research-development works at the stage of both their production (innovative phase) and subsequent implementation. It will enable to lower the costs of production, and next their prices, and therefore to increase their cost competitiveness on the national and international markets (it is also confirmed by theoretical research in this field);

- It is also necessary to pay more attention to the strategy of own brand building and CSR (corporate social responsibility) and to their influence on

the results in the range of increasing the competitiveness of the company;

- There is still infinitesimal awareness of the connection between the increase in innovativeness and the chance for the internationalisation of companies through the development of imports and exports, as well as the setting up of branches and subsidiaries abroad;
- It results from the research performed that electronic commerce has, and will have in the future, more and more influence on the performance of economic activity due to better and better technological development, lowering costs of access to the internet and giving possibilities of better customer service.

More detailed analyses of the issues described for the three areas of the textile

industry, which were investigated within the project Foresight, and conclusions from them will be presented in further articles that will be published in *Fibres and Textile in Eastern Europe* in the future.

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Gold Medal has been awarded to Polish artist Magdalena Soboń for her work 'Mars'

