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A Research for the Textile and Composite Material Sectors: Part 2: The Impact of Joint R&D and Prototyping Center on the Sectors

Mehmet KARAHAN
Bursa Uludağ University, Türkiye, mkarahan@uludag.edu.tr
Muhammad Shaheer TAHIR
National Textile University, Pakistan, tahirshaheer4087@gmail.com
Nevin KARAHAN
Bursa Uludağ University, Türkiye, nkarahan@uludag.edu.tr

Abstract
This article provides a thorough examination of the textile industry in Bursa, with a focus on technological textiles and composite materials. Using a rigorous questionnaire survey, the study collected responses from a varied variety of textile enterprises in the region to investigate industry practices, technological breakthroughs, and operational problems connected to composites and advanced textiles. The study looked closely at the function of the Bursa Technology Coordination and R&D Centre (BUTEKOM), a crucial institutional participant in the sector's research, development, and innovation. The data show that 52.90% of enterprises rated the impact of the BUTEKOM initiative on their competitiveness as moderate, 29.40% as strong, and 11.80% as extremely low, demonstrating varying levels of gain from such institutional support. This study highlights the importance of BUTEKOM's initiatives in fostering innovation and competitiveness within Bursa's textile industry.

Keywords
technical textiles, composite materials, questionnaire survey, BUTEKOM, Bursa

1. Introduction

The demand for technical textile products, which stand out with their specific physical and functional properties and performances in global markets, is increasing day by day [1-10] unlike products such as ready-made clothing, upholstery, and home textiles conventionally produced by the textile industry. The market continues to expand as technical textiles are used by an increasing number of end users in various industries such as agriculture, construction, healthcare, transportation, packaging, sports, environmental protection, and protective clothing [11]. Türkiye maintains its place among all the countries in the world, especially in the production and export of technical textiles and its export rates are increasing gradually [12-14]. It is predicted that the competitive power in global markets will increase as new technologies are developed in the production processes of technical textiles, which have higher added value compared to conventional textile products [15], and the increase in qualified personnel accompanies this. It is thought that the expectations that the fluctuations created by the COVID-19 pandemic in demand and supply will end as of the current year and the nature of the transformations brought about by the international agreements that are closely related to Türkiye, such as the European Green Deal [16], will become clearer and increase the search for new markets by the manufacturers.

Textile and composite material sectors are among the sectors where competition is most intense in the world compared to other sectors. For this reason, it is known that companies in these sectors are constantly trying to improve themselves. It is clear that research and university collaborations, especially in these two sectors, need to be further developed. Bursa Chamber of Commerce and Industry (BCCI) in Bursa is developing macro projects that will directly contribute to the development of many sectors. The textile and composite material sectors have been the most emphasized sectors. Three centers of excellence and two prototyping centers for these two sectors are some of the macro projects implemented by BCCI. With these centers, companies are supported in both basic R&D and prototyping

and commercialization stages of the sector. With these structures, these two sectors have reached structures that will form TRL 1-7 levels under the same roof from basic R&D to commercialization. BCCI has also focused on clustering activities. Currently, 25 different clusters have been established throughout Bursa, and some of these include the textile and composite industries. In our previous studies, we published articles on the activities of these sectors such as market [17-25], competitiveness, R&D and clustering [25-26]. There are different works been done on composites as well including the effect of weaving structure and hybridization influence on the woven carbon-epoxy composites [27] and the quasi-static behavior of three-dimensional integrated core sandwich composites under compression loading, highlighting their mechanical performance and structural integrity [28]. These studies were studies that showed the national and international competitive power of these sectors, specifically for Bursa. This study reveals the current situation of the textile and composite sectors. In this current situation, it is aimed to see the weaknesses and strengths of the sectors and to determine strategic intervention areas. Thus, this study also has a content that reveals Türkiye's own potential in technical textiles and composite materials.

2. Methodology

A comprehensive methodology was done for collecting the data for "Composite Material and Technical Textile Prototype Production and Application Center Technical Assistance Project". Data was gathered through conducting a survey with the enterprises in Bursa that operate in the technical textile and composites industry, using the questionnaire form in [20]. The companies included in the interview were identified based on the "technical textile and composite value chain and cluster analysis" study carried out in conjunction with BUTEKOM, which is detailed in [22]. Prior to the survey, calls were placed to the companies, and the individuals who would respond to the questionnaire were decided upon in concert. The fact that there were authorized individuals who could respond to the survey questions was taken into consideration when choosing the company representatives who will take part in the interview. The interviewees were given the assurance that the material they submitted would only be utilized in the context of the project, allowing them to speak candidly. Microsoft Excel and IBM SPSS 25 were utilized in the data analysis.

Using this strategy, a complete market analysis of technical textiles and composites was undertaken for various Bursa-based enterprises. The collected data revealed which improvements needed to be made in the latter stages of technical textile and composite production.

3. Results

The analysis of the data obtained from 53 companies operating in the field of technical textiles and composites in Bursa by survey method is given below.

The field of activity of the companies participating in the research is given in Table 1. As can be seen in the table, the most active area of the companies participating in the survey was composite with 30.4%. Composite was followed by fabric technology with 30.4%, industrial textiles with 21.7%, automobile and transportation textiles and conventional fabrics with 8.7%.

Table 1. Fields of activity of companies

Sector	%	Sector	%
Composite materials	30.4	Geo-Textiles	4.3
Clothing textiles	21.7	Medical Textiles	4.3
Industrial Textiles	21.7	Agro-Textiles	0.0
Automotive and Transportation Textiles	21.7	Home Technical Textiles	0.0
Conventional Cloth Manufacturing	21.7	Smart Textiles	0.0
Building Textiles	8.7	Oeko-Textiles	0.0
Sport Textiles	8.7	Pach-Textiles	0.0
Protective Textiles	8.7		

The list of product groups produced by the analysed companies is given in Table 2.

Table 2. Product types of companies

• Rail systems components
• Interior and exterior trim for aviation and defence industry
• Plastic Injection Parts (Automotive Industry-Aviation)
• Extrusion tubing and 3D monofilament manufacturing
• Painting auxiliaries and water repellents
• Decorative curtains
• Upholstery fabrics
• Indoor heat and light control
• Coated fabrics
• Pleated curtains
• Suitable for digital printing: Wall Covering Fabrics, Baclit, Blackout, Roller, Canvas, etc.
• Natural fiber reinforced composite material
• Upholstery and curtain fabrics
• Electric automation and machine cooling fans
• Internal combustion sports aviation engine and components design and production
• Home textile, automotive textile
• Geogrid, geomembrane, geocomposite
• Pool suspension systems
• Work clothes, outdoor and medical clothing fabrics
• Functional and technical fabrics
• Coating blackout
• Tulle and backdrop group curtain fabrics
• Conventional textile and functional textile products
• Automotive interior plastics, headlight, body plastics and assembly
• Machinery and equipment facilitating automotive processes
• Automotive and boat composite parts production and boat design
• Knitted upholstery fabric production
• Knitted mattress fabric
• Curtain coating
• Polyethylene foam

3.1. Share of R&D and design expenditures in turnover

As can be seen in Figure 1, the share of R&D and design expenditures in turnover decreased from 6.59% in 2021 to 5.77% in 2023 and increased to 7.45% in 2024 (forecast).

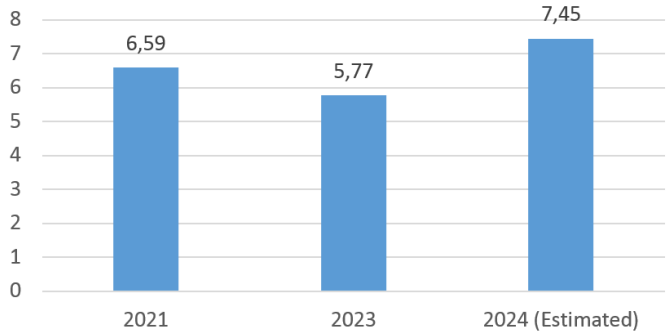

Fig. 1. Statistical share of R&D and design expenditures in turnover of companies (%)

3.2. Number of employees in the R&D unit

The number of employees in the R&D unit of the companies over the years is given in Figure 2. While the average number of employees in the R&D unit was 8 in 2021 and 2023, it was 9 in 2024.

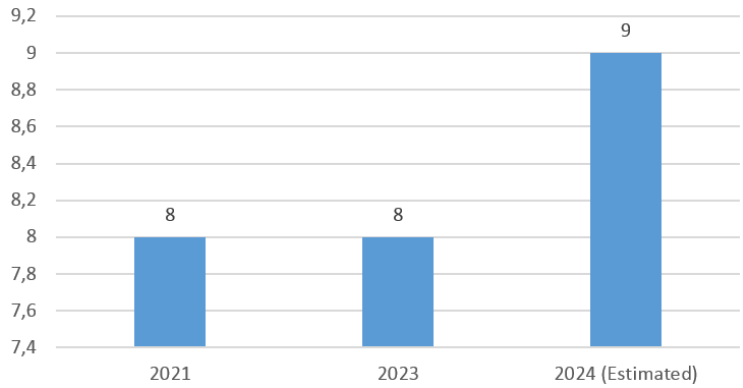

Fig. 2. Number of employees in the R&D unit of companies

3.3. Awareness of BUTEKOM

Have you heard of BUTEKOM? All of the companies participating in the survey answered "Yes" to the question (Figure 3).

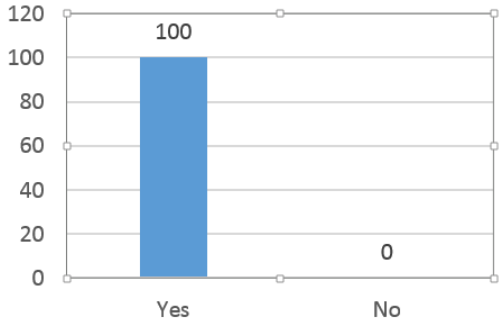

Fig. 3. Have you heard of BUTEKOM?

3.4. Level of utilization from BUTEKOM project activities

As can be seen in Figure 4, 73.9% of the companies benefited from BUTEKOM project activities. The proportion of companies stating that they do not benefit is 26.1%.

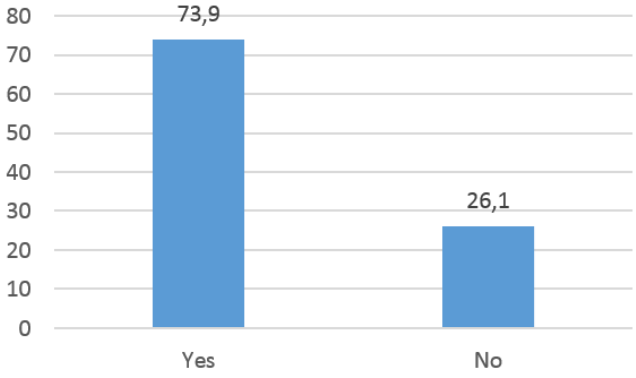

Fig. 4. Benefit level from BUTEKOM project activities of companies

3.5. Considering getting service from BUTEKOM

In Figure 5, the proportion of companies that do not benefit from the project activities carried out by BUTEKOM but intend to receive services is given. 100% of the companies that have never benefited from the project activities carried out by BUTEKOM have stated that they are considering receiving services from BUTEKOM. The rate of companies that answer no is 0%.

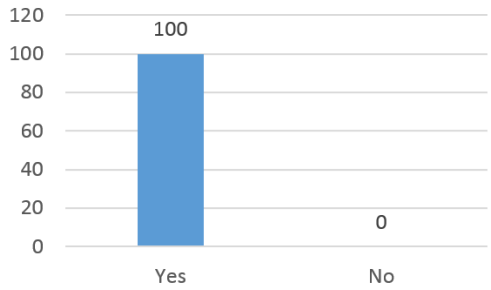

Fig. 5: Considering getting service from BUTEKOM by companies (%)

3.6. The Impact of benefiting from the BUTEKOM project on the company's competitiveness

The distribution of the answers given to the question asked in order to reveal the effect of benefiting from the BUTEKOM project on the competitiveness of the company is given in Figure 6. As can be seen in the graph, 52.90% of the companies stated that the effect of benefiting from the BUTEKOM project on their competitiveness was at a moderate level, 29.40% was at a high level, and 11.80% was at a very-low level.

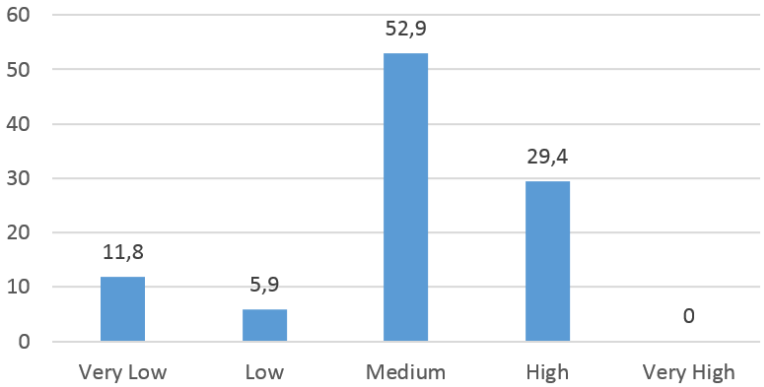

Fig. 6. Impact of BUTEKOM project on competitiveness of companies (%)

3.7. Benefit of project activities

Benefit of Technical Trainings Provided within the Scope of Project Activities:

The opinions of the companies about the benefits of the trainings on technical issues given within the scope of the project activities are reflected in Figure 7. As can be seen, 47.6% of the companies included in the research think that the benefit of the trainings on technical subjects is at a moderate level, while 23.8% think that it is high, 14.3% think that it is very high, 9.5% think that it is very low and 4.8% think that it is at a low level.

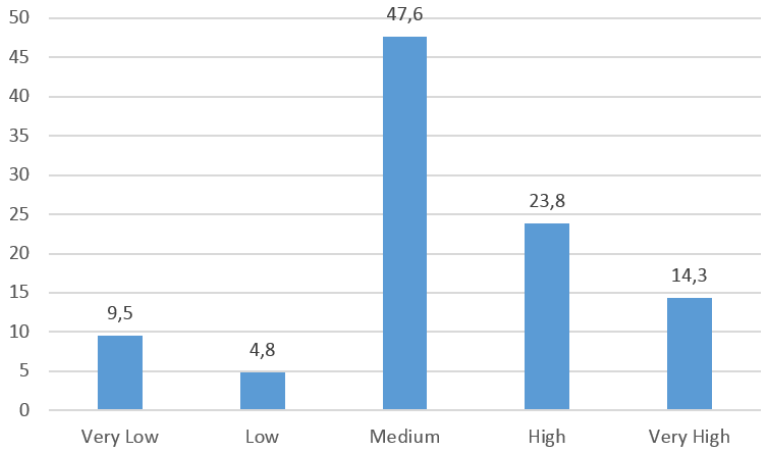

Fig. 7. Benefits of training on technical subjects of companies

Technical Consultancy on New Product Development and R&D

Technical consultancy on new product development and R&D of the companies within the scope of the research (e.g. for technical textiles) are given in Figure 8. Accordingly, while the rate of companies that think that the benefit of technical consultancy on new product development and R&D is high is 47.60%, the rate of companies that think as medium is 28.60%, the rate of companies that think it is very low is 14.30%, and the rate of companies that think it is low and very high is 4.80%.

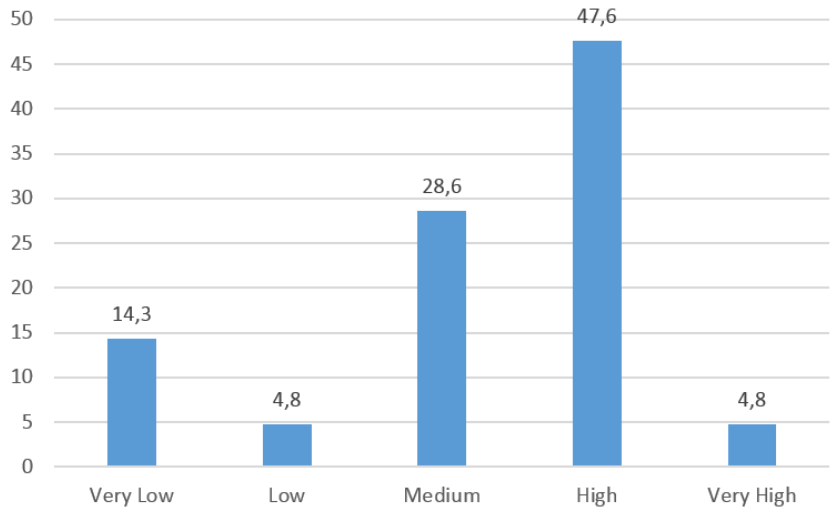

Fig. 8. Benefits of technical consultancy on new product development and R&D of companies

BUTEKOM's Facilities, Machinery and Technology

The distribution of the answers given by the companies participating in the survey about the benefits of BUTEKOM's facilities, machinery and technology is shown in Figure 9. Accordingly, the rate of firms reporting high levels of benefit is 52.40%. The proportion of firms reporting moderate utility was 28.60%, the proportion of firms reporting very high utility levels was 9.50%, and the proportion of firms reporting very low and low utility levels was 4.80%.

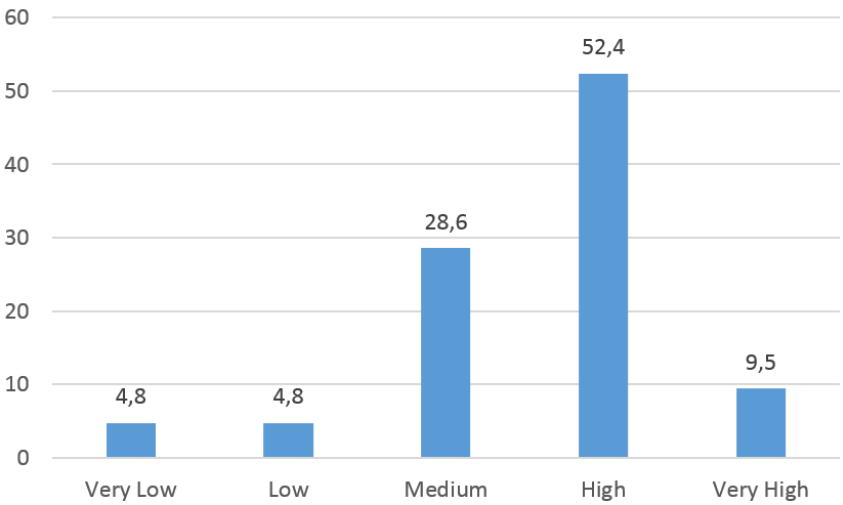

Fig. 9. BUTEKOM machinery and technology satisfaction degree of companies (%)

Mentoring/Consultancy on Product and Process Development

Figure 10 shows the opinions of the companies participating in the survey on the benefits of mentoring/consultancy activities for product and process development. Accordingly, 38.10% of the firms think that the benefit obtained from these activities is at a high level, 23.8% is at a medium level, 14.30% is at a low and very high level, and 9.5% is at a very low level.

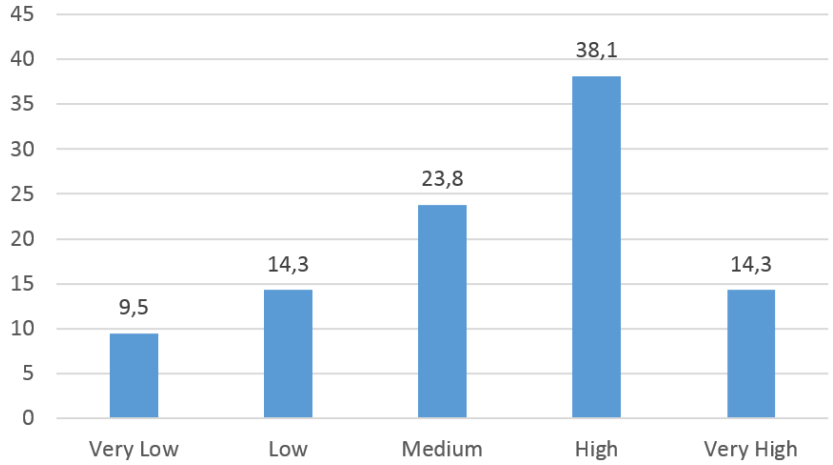

Fig. 10. Mentoring on product and process development of companies (%)

Market Research for Technical Textiles and Composite Materials, Support in Finding New Export Markets and Customers

The opinions of the companies participating in the survey on the benefits of the support provided for market research, new export markets and finding customers for technical textiles and composite materials are given in Figure 11. As can be seen in the graph, 33.30% of the firms reported a moderate level of benefit related to these supports. Similarly, 23.80% of the firms reported a very low utility level, while the rate of firms reporting a benefit level as low, high, and very high was 14.30%.

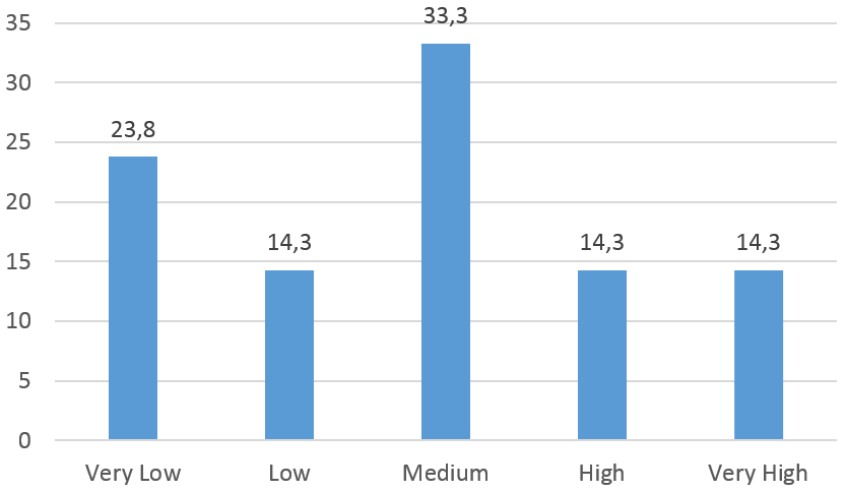

Fig. 11. Domestic/external market research for technical textiles and composite materials of companies (%)

Use of BUTEXCOMP Machinery and Equipment for Production and Innovation Purposes

The opinions of the companies on the benefit level of BUTEXCOMP machinery and equipment for production and innovation purposes are given in Figure 12. Accordingly, 38.10% of the firms reported that they achieved medium, 33.30% high, 14.30% low, 9.50% very high and 4.80% very low utility level.

Support for Access to Financial Resources for the Initiation of New Technical Textile and Composite Products and Processes

The opinions of the companies participating in the survey on the benefit of access to financial resources support for the initiation of new technical textile and composite products and processes are given in Figure 13. As can be seen in the graph, 33.30% of the firms reported that the benefit of access to financial resources support was low, 23.80% very low and medium, 14.30% high and 4.80% very high.

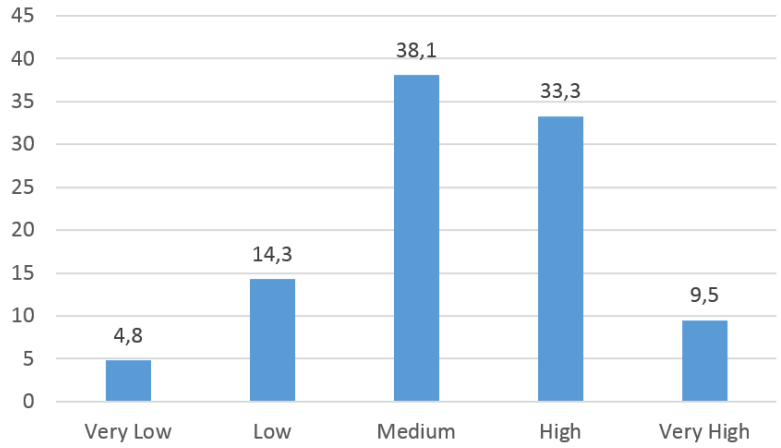

Fig. 12. Using BUTEXCOMP machinery and equipment for production and innovation purposes by companies

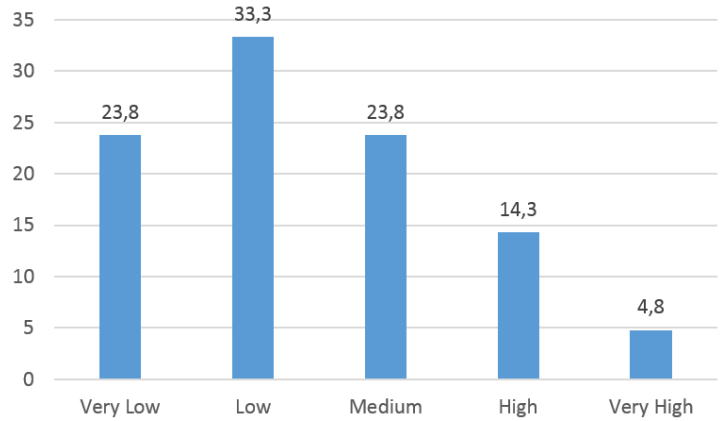

Fig. 13. Support for Access to Financial Resources of companies (%)

4. Conclusions

This study delves deeply into Bursa's textile business, with a concentration on technical textiles and composites. The data show that the sector is quite active in these specialised domains, with a strong emphasis on direct export techniques. Specifically, 38% of studied enterprises export their products directly, 34% utilise a combination of direct and intermediary export methods, and only 4.3% rely entirely on intermediaries. This shows a definite preference for direct export tactics throughout the business.

The estimated 78% rise in turnover for 2024 demonstrates robust growth prospects. The survey also notes that 39% of revenues come from international markets, demonstrating the sector's tremendous worldwide reach. Employment data have steadily increased over the last three years, showing a strong and rising workforce. Technologically, the industry is doing above average, with a noticeable increase in the turnover share of high/medium-high technology products.

In terms of R&D and design, while there was a decrease in the proportion of turnover dedicated to these areas in the previous year, expectations are for an increase in 2024, along with a predicted rise in R&D staffing. The steady increase in certified products reflects ongoing quality improvements and compliance with industry standards

The survey reveals a high degree of awareness about the BUTEKOM (Bursa Technology and Innovation Centre) program, with 100% of enterprises recognizing its presence. Furthermore, 74% of respondents claim that they make extensive use of BUTEKOM's project activities, and a comparable number are considering getting services from the organization. However, their perceived impact on competitiveness is limited. Despite this, the research has significantly advanced expertise in technical fabrics and composite materials.

The advantages of BUTEKOM's training, technical consulting, and support for new product development and R&D are well acknowledged. Support for market research, access to financial resources, and the development of new export markets are scored lower, indicating that more work is needed.

Furthermore, the analysis shows a consistent increase in input costs, particularly energy, with five firms reporting no change in the proportion of input expenses to turnover, one company reporting a decrease, and four companies reporting an increase. This consistency in input costs despite substantial inflation and currency volatility is noteworthy. The findings indicate that the project's attempts to lower input costs have been successful, although further review and adjustment are necessary.

In conclusion, this study presents a thorough examination of Bursa's textile sector's current practices and prospects. It emphasizes important breakthroughs and areas of strength, particularly in technology capabilities and direct export tactics, while also recognizing potential to improve support mechanisms for market research, financial access, and export growth.

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