CompoWIN
More Skilled Hands for Hi-Tech Production

COMPOSITE INDUSTRY

Competence and Skills Framework

Final Comparative Report

Executive summary

Project: CompoWin – More Skilled Hands for High-Tech Production

2020-1-BG01-KA202-079268

www.compohub.eu

Context

Composite materials are modern materials made out of glass fibres, carbon fibres and other constituents. Composites are the material of the future. Composite parts are all around us, from carbon fibre sports accessories (skies, helmets, bicycles) and their numerous applications in cars, aircraft, marine industry, robots, bathtubs, and so forward. They solve problems, raise performance levels and enable the development of new innovations in markets such as transportation, construction, corrosion-resistance, marine, infrastructure, consumer products, electrics, aerospace, appliances, and business equipment. Due to their specific properties, the composite materials can be more durable, lighter or less expensive when compared to traditional materials. Therefore, it is generally predicted that composites will quickly become more important than metal. The future of the global composites market is bright. The expected growth of 5,1% over the period 2017-2022 has been already exceeded. Although it is one of the few industries still valuing manual labour, the composite industry is characterised by a high added value.

However, as with many other industries, the composite manufacturing sector companies suffer from the lack of qualified personnel and fluctuation of the workforce. To cope with that issue, many companies are providing in-house training for employees. They are investing sufficient resources in raising the qualification of their companies' managerial and production staff.

To address all these challenges, project CompoWin is aimed to help maintain and increase the competitiveness of EU manual labour. This is done by supporting the composite industry by producing a holistic, usable and attractive training system for future composite fabricators. It will assist, VET teachers/trainers of general technical knowledge to develop the necessary skills and methodologies to rapidly convert into teaching basic composite techniques. In addition, the newly developed content could be easily adapted and customised for the need of in-house training in composite companies or for reskilling current employees to work with composite materials and techniques. The second equally important result will be the ability to introduce this training system very rapidly into organisations with no previous experiences with composites. Such an organisation would need a list of the basic material conditions before attempting a composite training course. This list will serve as a basic reference for an initial go/no-go decision by the educational organisation manager whether to adopt the training or not.

The present Comparative Report is one of the milestones of the CompoWin project as it aims to deliver a more comprehensive background information on the current state of development of the composite industry in participating countries and existing challenges that the sector is facing (i.e. lack of qualified personal, limited R&D, lack of VET programmes, etc.). The second part of the research process aimed to draw a more comprehensive overview of the composite manufacturing industry, considering current employment trends and future technological development prospects. As a result, project partners produced a Catalogue of Opportunities and Barriers to Employment (COBE) and the Potential Technologies Focus Catalogue (PTFC). The research and analytical activities were implemented by a consortium of project partners of five European countries, i.e. Bulgaria (Business Information and Consulting Center – Sandanski), Croatia (3D Grupa Cluster), Estonia (Kuressaare Ametikool), Germany (SBG) and Slovenia (RRA and AFormX).

OVERALL ECONOMIC PROSPECTS

The ongoing COVID-19 crisis continues to evolve, significantly impacting the economy and the business environment across EU countries. SMEs were no exception and were severely affected, suffering from reduced consumption, limited market access, supply chain disruptions, imposed social distancing and travel bans worldwide. Even though the crisis provided opportunities to some, many SMEs were affected negatively and sometimes in a devastating way. **Export-focused enterprises suffered due to supply chain disruptions, collection or receivables and altered demand structure in their international markets. Trends are visible, but long-term impacts are hard to be projected. The building, construction, and automotive industries are some of the worst-hit sectors due to the pandemic.** Slow recovery is expected in these sectors because of other macroeconomic factors such as job losses and debt crises. This slow recovery is anticipated to hamper the composite market growth in the long run. **The transport sector with the core fields of automotive, public transport, commercial vehicles and aviation, and the construction and infrastructure sectors are of particular importance for the composite industry.**

Considered purely in terms of production volume compared to competing materials, the composites market is a relatively small market. It is clear that composites will not reach the gigantic production quantities of concrete or steel in the near future. **The market is extremely agile, and the growth rates are high. An increase in importance can also be seen in the industries that are supplied with composite components.**

There are currently numerous challenges in the industrial environment. Business models had to and must continue to be adapted. Logistics chains were in some cases significantly disrupted, and there are still glaring bottlenecks today. A shortage of raw materials, the sharp rise in the prices of many raw materials and, most recently, the shortage of chips have a major impact on various application industries. Nevertheless, **the picture in the composites industry is optimistic**.

The **countries that have participated in the research process reported different levels of development of the composite manufacturing industry**, including the current state of composite materials, existing markets, technological practices, trends, etc. **In Bulgaria**, the research team found that the number of composite manufacturing companies is relatively low. Data showed that the largest consumer of composite materials in Bulgaria is the automotive sector, followed by construction, light manufacturing, dentistry, aeronautical and defence industry, marine industry, etc. It is evident that there are development contrasts concerning the composite sector's overall development. **Neighbouring countries such as the Republic of North Macedonia and Romania also have long-term traditions and active companies in the field of the composite industry.** This creates opportunities for fostering the B2B cooperation in the sector and developing joint business and educational initiatives, e.g. clusters, staff exchanges, good practice and know-how transfer, etc.

In Croatia, the **share of companies engaged in composites is relatively low (4.8%) in comparison to other enterprises of the chemicals, rubber and plastics manufacturing sector.** It employs a total of 3.6% of employees compared to 18.8% of employees in the production of plastic and rubber products. There are companies that manufacture parts for the transportation, automotive and shipbuilding industries. There is also the production of advanced composite products for various purposes (automotive, bicycle and motorcycle industry, vessels, aircraft, military industry, wood industry, construction). **Croatia also has a developed shipbuilding industry.**

In Estonia, as in other countries, the availability of information about the current use of composite materials is non-sufficient, concluding that composites share just a small part of the Estonian manufacturing industry. However, there are five distinctive economic industries, i.e. shipbuilding; manufacturing of hot tubs, including heated ones, tanks, including septic tanks, sanitary products, industrial profiles and other products for construction. Most of the abovementioned companies export their products to Europe, for example Finland, Sweden, Denmark, Norway, Aland, Belgium, Germany, France etc.

German manufacturers produce the largest quantities of composites in Europe. In addition to the expected declines in the aviation and automotive industries, the two areas of infrastructure/construction and sport/leisure have been showing up over a longer period of time than the fields of application from which many respondents expect significant growth impulses for the composites industry. In Slovenia the main industries that produce composite materials include: automotive industry, including campers; aviation industry; marine and nautical industry; construction industry; wind industry.

CHALLENGES AND SUPPORT

The COVID-19 pandemic had a negative influence on the overall economic development of the European Union, bringing the steady economic growth and development accumulated over the past ten years to a standstill. In addition, the pandemic brought forward numerous industrial and economic development challenges that forced many small businesses to adapt to these new realities, diversify their production and manufacturing practices, cope with raw and other material deficiencies, logistic challenges, etc. The research results clearly showed that the composite manufacturing sector companies is mostly suffering from the lack of qualified personnel and fluctuation of the workforce.

On a policy level, the composite industry remains under the radar of policymakers in most countries. Currently, not many, if none, publications or strategic documents exist to provide a detailed outline of the development of the chemical, plastic, and composite industries. Therefore, little data is available on the existing key actors and stakeholders in countries such as Bulgaria, Croatia and Estonia as the sector remains relatively under the radar of industrial research and analysis conducted to draft some of the main strategic documents of in regards to industrial and economic development. Until governments and policymakers are not made aware of the importance of composite materials and the industry in general, there will be no progress in this area and no significant educational and training support changes to solve the big problem of skills deficiency. Despite the lack of specific support instruments, the research identified that there are various support programmes and funding instruments available in support of SMEs from the manufacturing industry in all countries. These financial tools were further increased to support the COVID-19 recovery of economies. However, in many cases, small companies do not have the necessary capacity to apply for and manage such projects. The research conducted in the frame of the CompoWin project showed that the existing structures and organisations providing support for the composite industry are not well developed and coordinated in all countries. As part of the research process, project partners in each country identified the existing umbrella organisations, stakeholders, potential target groups (i.e. SMEs of both groups, VET providers and institutions, etc.) and policymakers that are directly or indirectly involved in providing support to the composite industry.

Regarding existing stakeholders, in countries like Bulgaria, Croatia and Estonia, composite companies do not have an official branch association/organisation to safeguard their interests and carry out

different projects supporting their members' overall technological, R&D and skills development. European networks such as Enterprise Europe Network also provide various B2B services to SMEs, technological and research cooperation opportunities, innovation support, etc. In Germany, on the other hand, there are several large organisations and associations that represent the composite industry in the country. In 2013, four large organizations of the German composites industry founded a joint umbrella organization: the business association "Composites Germany". In Slovenia, the Slovenian Chamber of Commerce and Industry has established a Strategic Development and Innovation Partnerships (SRIP) that brings together representatives of the economy, knowledge institutions and the state in the target areas of the Smart Specialization Strategy (S4).

In regards to the existing educational programmes and structures in the field of composite manufacturing, the analysis shows similar deficiencies and limitations. There are very few projects that tackle these issues and only a few further professional training offers match the composite technologies to the requirements and needs of companies and offer them in short-cycle formats as professional further training offers.

In Bulgaria, since the composite industry is not well developed there is a lack of specialised subjects or educational programmes in the secondary, vocational, and higher education institutions that have been specifically designed for the needs of the composite industry. Universities offer certain subjects and majors that include some topics and practices related to composites and composite manufacturing techniques. In Croatia, secondary schools do not provide the opportunity to enrol in subjects related to composites. Universities are the first level where such majors are offered, and composites can be studied. There are two universities where such education is provided. In Estonia, under the coordination of the Association of Estonian Marine Industries, the only professional standard “Composite Recreational Ship Builder” was developed and introduced. The Kuressaare Regional Training Center is the only vocational school that has a Level 4 curriculum, “Composite Recreational Ship Builder”. In universities, composite materials are part of several specialised bachelor and master’s degree programmes. In Germany, due to the shortage of skilled workers in this industry and the lack of a “skilled worker qualification for composites”, employees are preferred to be hired and trained in-house. There are however several recognized training occupations. Both are dual training occupations in industry, regulated by the training regulations. The training period is three years (1) or 3.5 years (2). In Slovenia, as a result of the CompoHub project the National vocational qualification - Manufacturer of plastic composite products was developed to reduce the existing skills mismatch in the industry.

In all countries, in-house trainings are very popular among the companies operating in the industry.

SKILLS AND TRAINING SHORTAGES

As mentioned above, according to the results of the research process that was carried out in partner countries, one of the biggest challenges for the composite sector is the lack of qualified personnel and fluctuation of the workforce in the first months after employment.

This is most prominent in Bulgaria, where both participants of the VET sector and companies shared that there is a skills mismatch and a gap between the companies and the education/training institutions/providers. Due to the shortage of skilled workers composite industry and the relatively small number of companies operating in it, as well as the lack of a recognised profession or a vocational standard for composite workers, the few existing companies in Bulgaria seek to hire either skilled

workers or prefer to train employees through in-house training. Similar deficiency is also observed In Croatia. The workforce in companies in the composite industry is inadequately educated, educational programs are still relatively modest, and short-term training is more often related to safety at work. In Estonia, according to the majority of the companies and VET representatives that participated in the research process, one of the biggest challenges for the composite sector is the fluctuation of the workforce in the first months after employment. In Germany, employees who work in the field of composites often have different professional qualifications. The variety of technological manufacturing processes and use in hybrid applications are major challenges for companies and specialists. The need for employees who have a wide range of application-related knowledge of materials and joining technology will continue to increase. In Slovenia, potential employees in the composite industry can be trained under the National vocational qualification - Manufacturer of plastic composite products. However, there are no training organisations that provide a structured training to follow the National standard. This deficiency will be overcomed through the CompoWin project.

Regarding technological practices and necessary skills, most companies count on manual labour and relevant techniques. The process is slow as automation is missing or it is applied by larger companies, producing a high quantity of materials (e.g. companies of the plastic industry, ceramic composites, etc.). Pultrusion is popular among larger companies, producing FRP pipes, rods and other forms of constant cross-sections. Autoclave equipment is expensive and used mostly by bigger companies. Due to the mostly manual labour and utilised processes, recycling the materials (e.g. FRP) remains a challenge as FR plastics are liable to a number of the issues and concerns in plastic waste disposal and recycling. This is because the FRPs are derived from two or more sub-products (i.e. polymers and monomers) that are difficult to return to their primary state. For that purpose, FRPs are difficult to recycle.

Regarding the necessary skills and competencies required by the composite industry, employers highlight that each potential employee should have motivation, willingness to learn, be able to work in a team, and meticulousness in carrying out his/her tasks. When discussing general skills needed in this sector, the most needed ones are grinding/finishing/cutting skills. Therefore, workers with previous experience or education in car painting, woodworking or construction are welcomed. Some companies prefer to employ workers with no skills at all because re-training is also an option, despite it might be both time-consuming and expensive.

Apart from some particular industries, e.g. nautical and aeronautical in Estonia and Slovenia, most VET providers do not have particular experience in conducting VET training for workers of the composite industry. There are no further professional training offers on the training market that transfer content from academic curricula, for example, from degree programs in microsystems technology or composite technologies to the requirements and needs of companies and offer them in short-cycle formats as professional further training offers. Additional qualifications in the field of vocational training cannot be found in this area either. Against this background, there is a great need to design and implement both additional qualifications and professional development offers. With additional qualifications, companies would be able to react to changing environmental conditions and qualification requirements at an early stage.

Regarding the most efficient teaching methods, including necessary materials to conduct trainings for staff in manufacturing industries, including composites, participants in the research process shared identical ideas and recommendations. As VET providers in most countries are not experienced in

conducting specific trainings for the composite industry, it is necessary to have detailed methodological guidelines for developing training plans by the VET providers, including the minimum requirements for the structure and contents of the training plan. These should complement the existing National Vocational Standards, as the one developed in Slovenia. Best practices from Estonia could be also transferred and utilised in the process.

As part of the training, in addition to traditional online and face-to-face delivery, production practice (i.e. work-based learning) would provide trainees with the opportunity for real-life work experiences where they can apply academic and technical skills and develop their employability. These will be especially important for composite manufacturing training, where most of the adopted and popular work practices and techniques are mostly performed manually. This is vital because the overall objective of each work-based training is to help workers acquire new knowledge and develop new skills that they can afterwards apply successfully in practice. It is important to share the Slovenian experience in preparing the vocational standard, as the development process complies with the ECVET requirements.

At present, the most used technique is mentoring approach at the workplace as for the training and education programs used, the most suitable method is a combination of theory and practice, there are also some online portals on this topic (some live, some online) and on-the-job mentoring as the most useful method for this type of industry.

The training programme should be marketed and promoted properly to the right audience and industry. For example, it could be beneficial for employees of the furniture industry to learn more about composites and how these materials could be integrated into future furniture models with the objectives to go "out of the box" and the standard products and deliver something new, smart, innovative and sustainable.

All these aspects are described in details in the relevant sections of the present report, providing a valuable insight into the composite industry existing technological trends and deficiencies.

Read the main outputs of IO1:

- Composite Industry – Competence and Skills Framework Repot (Full version)
- Catalogue of Opportunities and Barriers to Employment (COBE)
- Potential Technologies Focus Catalogue (PTFC)
- First Newsletter of the project