Expert insights in Europe's booming composites market

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Composites are a dynamic, high-volume growth industry in Europe.

Europe is an important location, among others, due to its very specific and efficient cooperation and joint technological developments between research and industry. From country to country, the industrial organization as well as the research landscape varies. In this highly sophisticated production technology environment, complex materials and often multi-material technologies are constantly developed and improved, which enables automated mass production and advanced lightweight technologies to stay in high wage countries. In this context, Germany figures as a leading supplier for lightweight applications, with enormous strength in the manufacturing and mechanical engineering sectors, many strong and successful SMEs and numerous OEMs in all end markets present on the market. Key segments are traditionally automotive, aerospace, and electronics, but there is also a focus on wind energy and building and construction (Fig. 1).

Traditionally, the transport sector with aerospace and automotive represents more than a third of the market. The B&E sector represents almost the same proportion, with a value in Europe of 8 billion euros, and where approximately 900,000 tons of composite materials are used. Examples of how composites can be used in the building industry can be seen by the Dubai-based Company AFFAN, which is making a large variety of buildings, ranging from large entrance areas of skyscrapers to complete logistic centers, museums, and even private villas in composites, using resin infusion and prepreg technologies with carbon and glass fiber reinforcements. While in the Middle East and Asia, the restrictions and standards are not as tight as in Europe or in Germany, it is expected, that the market, specifically in these regions as well as in South America, will grow even faster than in Europe. The most advanced use for composites in infrastructure is actually the rotor blades for wind turbines and the composite pipelines and vessels (Fig. 2).

Research and industry working shoulder to shoulder
Specific to the German market is the close cooperation between research and industry. For example, at the Campus of RWTH Aachen University, research institutes cooperate closely with industrial partners in a pre-competitive way in order to drive innovation and further develop cost-effective, integrative, high-volume production technology. In June 2017, the AZL partner network counted over 80 industrial partners which are cooperating with 9 research institutes on the Campus, which are linked to lightweight technologies. Under the auspices of AZL, joint studies are being carried out with the aim of identifying new applications or market opportunities for specific technologies or, the other way round, new and often multi-material technologies for specific applications. Joint partner projects are also being carried out, in which 10–15 companies share the cost of new pre-competitive developments, such as developments of key processes like thermoplastic composites, high-speed RTM, or pipes and vessels. Another focus is on finding out new possibilities for using high-performance SMC. HP-SMC means composites are made of various fiber reinforcements, from carbon to glass, with continuous and discontinuous fibers as well as various new resins, such as polyester, vinyl ester and epoxies, opening the door for more structural applications in the automotive industry, such as floor pans, as well as new applications for high-speed trains and other transportation. This SMC workgroup has also requested AZL to perform a market and technology study for the development of design guidelines for HP SMC.

Another study focuses on identifying new potentials for composite technologies in the building and infrastructure market. For the latter, over 25 partners have joined along the entire value chain, from raw materials to OEMs such as producers of facades, panels or window frames. An interesting sub segment is the use of fiber reinforced concrete.
AZL is part of the new group for integrative production technology on the campus of RWTH Aachen. It is the largest group with offices for more than 800 people. The group around the AZL is a veritable landscape on its own, where companies are having their own offices and work shoulder to shoulder with the researchers of the universities. Very recently, a branch of this group of integrative production technology was the scooter company which was acquired by the German post DHL. This branch is now producing approximately 10,000 electrical vehicles per year in Aachen, Germany, for the German post offices, using also affordable lightweight materials.

Together with its partners, AZL can also apply for government-funded projects, for example from the EU or the German government of BMBF or BMWI. Last but not least, an important service is the business development support in the field of new markets and new regions. AZL business partners will be focusing later this year on Eastern Europe, while meeting with industrial partners and government representatives in Poland (Krakow) in October (Fig. 3).

The role of a strong industry organization
Germany is traditionally very strong in the manufacturing sector and has a high percentage of manufacturing in relation to GDP with 24%. This represents thousands of jobs that should be protected through innovation, complex processes and therefore high barriers for moving away. In comparison, Italy has 15%, Spain 13%, France and UK each 11% of the GDP in the manufacturing sector (values from 2014).

Particularly Germany as a country is highly dominated by the presence of various trade associations. Traditionally, the German industry has been very fragmented with thousands of small and medium-sized enterprises, which have been regrouped and organized in the last decades through industrial research associations to represent their common interests and speak with one voice. This has been particularly successful in the composites industry, which is driven by a lot of break-through innovations.

The role of these trade and industrial associations varies from regional objectives, like companies regrouping around the aerospace industry in the North of Germany or the automotive industry in the south of Germany to overarching goals within an organization aiming to represent common interest on a more global scale. The umbrella organization Composites Germany which is the strongest on the German lightweight market, regroups Germany’s four leading trade associations, which are active in the traditional glass fiber industry (AVK), in mechanical engineering industries (VDMA), in the carbon fiber sector (Carbon Composites, CCEV), and in aerospace (CFK Valley). In total, this means over 760 members in industry and research along the entire value chain, raw materials, processors and molders, including OEMs.

As an organization, Composites Germany informs and connects people, businesses, developments and needs regarding composites as a key technology in order to support Germany’s economic growth. Advanced lightweight materials like composites bring sustainable and high-quality workplaces to the country. The business is further growing and expanding due to the constant high-quality technological developments and drive for innovation as well as due to the aim for metal replacements through lighter materials.

The government has also recognized the importance of the industry in their “coalition agreement” as glass-fiber and carbon-fiber reinforced composites have both strong growth rates. As per this agreement, with the aim to achieve its climate targets, and for Germany’s strategic innovation policy, the government now focuses on the support of the lightweight industry, next to electric mobility and digitization. The government estimates the wind market, building and infrastructure, as well as mechanical engineering to be the main future markets with a strong focus on hybrid lightweight technologies. A big potential is particularly seen also in ceramic composites, in which Germany is world market leader. At federal level, the framework for a broad industrial use has been under construction since 2015, with a specific contact person responsible for lightweight at the Ministry for Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie), abbreviated BMWi, a cabinet-level ministry of the Federal Republic of Germany. Next steps on this level are the creation of an overview of lightweight related activities in Germany, to create an exchange platform about new and advanced technologies based on company reports, and support the networking between all stakeholders and players on the market. The government has also identified
a need for improvement in the area of vocational education and training, and various governmentally-funded projects are ongoing, in which especially the cooperation between various partners in the industry is financially supported.

Thus, one main focus of Composites Germany’s work is the lobbying, meaning a close cooperation with representatives of the German government and to support them in their goals to achieve further energy and resource efficiencies, making the country’s industry competitive and saving and creating jobs.

The organization Composites Germany stands up to prevent the technology from moving to low-cost countries and supports and promotes innovation and technology, thus, the constant development of energy and resource-efficient processes, and products leading top-class performance applications to their final breakthrough.

The size of the market
Composites are a combination of fibers and resins. The global composites material market (fibers and resins) represents approximately 12 million tons in 2016. With 99% in volume, glass fiber is here determining the market size, versus 1% in volume for the carbon fiber market. In Europe, the overall composites material market for fibers and resins can be estimated with 3 million tons. Glass fiber reinforced thermosets represent 33% (936 000 tons) hereof, glass fiber reinforced thermoplastics with non-crimp fabrics represent 12% (350 000 tons), glass fiber reinforced thermoplastics with short fibers 48% (1.3 million tons), glass fiber reinforced thermoplastics with long fibers 6% (183 000 tons) and carbon fiber 1% (35 000 tons). The industrial value for finished composite parts is 30.85 billion Euros which is half the size of the lightweight aluminum market. Globally, the glass fiber market grew in 2016 at an annual 5–6% rate, with Europe representing a quarter of this market (3 million tons). The global carbon fiber composites market grew even faster with an annual growth rate of approximately 10%, while the overall tonnage in 2015 was 91,000 tons (fibers and resins). Here, automotive and wind turbines are the fastest growing segments. After a serious economic crisis in 2008, which impacted the European industry dramatically, the composites Industry in Germany and Eastern Europe have benefitted the most. While until 2009, the largest markets were Spain, Portugal and Italy, now Germany is the largest market in Europe with a market share having increased from 12.9% (2007) to 20.1% (2016) (Fig. 4).

Summary and outlook
In the last decade, a growing boom was recorded for many industrial markets and applications in the composites industry, as lightweight has so many advantages, like for example, it leads to better fuel efficiencies and less emissions. In 2016, the European Composites market represented 30 billion Euros (worldwide over 125 billion Euros) with a growth rate of 6–8%.
**FIGURE 3**
Example of a composite building (Image courtesy of AFFAN).

**Volume in ktons**

- GFRP(TS)  - GFRP(TS/NCF)  - GFRP(TP)  - GFRP(TP/LFT)  - CFRP(TS/TP)

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48%  33%  6%  1%  12%
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- The TP market is the largest segment (54%) and with the fastest growth
- CFRP (TS) represents only 1% in volume

**FIGURE 4**
The European Composites market in Volume (2016) (Image courtesy of Dr. Michael Effing, Composites Germany).
Further innovation and cost reduction are needed in order to allow mass-production to stay and further grow in Europe and Germany. There are opportunities to reduce cost, on all levels of the process chain and in the production method like this is the case for the integrative manufacturing. Ways to optimize and smooth processes and intensify the automation of processes are constantly in the focus of the research institutes. One example is the combination of two processes, the thermoforming of a thermoplastic preform and the injection molding to male thermoplastic hybrid components with short and continuous fiber reinforcements. Researchers are currently developing methods for a further cost-reduction of up to 40% by 2020. In glass fiber production, they are working on the improvement of glass properties like tensile strength and stiffness. In carbon fiber, the focus would be on modified conversion methods with reduced energy consumption as well as on further innovation, cost reduction and efficiency increase of the precursor technology. The expected cost reduction is here up to 20%. In the matrix system, researchers aim to achieve shorter cycle times in the component manufacturing for an additional up to 10% savings. In sum, there are still various opportunities to improve and smooth the production chain in order to assure cost reduction in manufacturing and, in the end, for the user.

This industry needs standards and norms agreed by all parties along the value chain in order to quickly design and engineer new parts. Stable values and reproducible results can be reached and simplify the production.