Supply Chain Excellence in the German Aerospace Industry

Status Quo and Prospects for Germany as a Center of the Aerospace Industry

Prepared by the Supply Chain Excellence Initiative for the Federal Ministry for Economic Affairs and Energy
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Current situation

This study is based on a comprehensive survey of German aerospace industry suppliers. Its aim is to provide an overview of the German aerospace supplier industry and then determine steps for improving their competitive capabilities in Germany. The study was prepared by the Supply Chain Excellence Initiative (SCE) on behalf of the Federal Ministry for Economic Affairs and Energy. It includes all value-added steps in the relevant market segments. Data was collected on the segments relevant to production and sales of aircraft. Air transportation and airport infrastructure were not included in the study.

Goals of the study

The study aimed to gain a comprehensive overview of the German aviation supplier industry. By comparing the results with the changing demands facing the aerospace value chain, the study should provide information on the status quo and competitive position of German aerospace suppliers.

In order to gain a broad picture of the condition and competitiveness of the supplier industry, the study looked at all companies and sites along the entire value chain.

Supply Chain Excellence (SCE) Initiative

Structural change in the aerospace industry is gaining speed. Traditional supplier relationships are under pressure from industrialization of the value chains. As a result, some areas of the supplier industry are at risk of losing their competitiveness in the international market.

The Supply Chain Excellence (SCE) Initiative was founded in 2015 to help aerospace suppliers navigate through the structural change that had just begun. This initiative has enabled all aerospace associations, clusters and initiatives in Germany to work together with the Federal Government, the Länder and industry to achieve this goal for the entire German aerospace industry.

Supply Chain Excellence means active development of stable and agile supply chains at all value-added steps – the goal and task of all members of the Initiative. The Initiative utilizes and funds successful national and regional activities and structures, and actively links them. The close cooperation between government, companies and associations is a keystone of success of these efforts.

The Supply Chain Excellence Initiative (SCE) was charged with conducting the study. The large roster of members in this initiative ensured that all aerospace industry regions in Germany were included, and also provided access to the smaller companies in the aerospace supplier industry.

The study is focused on the industry segments of the aerospace supplier industry – aircraft manufacturing and maintenance. Other equally significant industry segments not included in this study were airport infrastructure, the airlines and flight operation.

In six work groups, activities are planned and implemented to assist companies in the supply chain (see Figure 1). The parties involved laid the foundations for these areas during an intensive participation process with all of the players of the industry.

To ensure that the initiative is optimally directed to the needs of the companies and to get an overview of the areas requiring action in the specific aerospace regions, the Federal Ministry for Economic Affairs and Energy (BMWi) in late 2015 instigated a project to work out a technical overview of the German aerospace supplier landscape.
The study is based on this groundwork of the SCE Initiative. In addition to qualitative analyses, the study developed an overview of the market for German suppliers with an online survey of the entire German value chain of the aeronautical industry.

This multi-step procedure created a general overview of the relevant thematic fields and actors, and defined approaches for systematic implementation of the initiative. Building on this, specific support activities were defined that form the guidelines for future work of the SCE Initiative.

**Implementation Consortium**

The study was commissioned by the Federal Ministry for Economic Affairs and Energy as a joint project with the Supply Chain Excellence Initiative. Participants in this initiative include all 14 Länder associations and regional clusters, the BDLI (German Aerospace Industries Association) and SPACE Deutschland e.V.

Brigitte Zypries, Federal Government Coordinator of German Aerospace Policy and Federal Minister for Economic Affairs, has been the sponsor of the Initiative since 2015.

The economics ministers of Bavaria, Lower Saxony, Hamburg and Baden-Württemberg have also taken on sponsorship for the Initiative (see Figure 2).
Methodology

This study covers all relevant topics and actors of the German aerospace supplier industry, providing starting points for a systematic implementation of the SCE Initiative. First, the industry supply chain was broken down into sub-segments. In addition to the major areas of aircraft construction – Structural Component Construction, Engines, Cabins and Systems – segments relevant for production and development were also reviewed (Engineering, Testing, Research, Mechanical and Plant Engineering, Tools), as well as aircraft Maintenance, Repair and Overhaul. In addition, for each of these horizontal groups the vertical value chain was brought into the individual steps of the supplier pyramid (see Figure 3).

This is a tier structure, which, starting with the manufacturer (also known as an OEM = original equipment manufacturer) describes the supplier interrelationships in the form of a pyramid of direct supplier relationships (Tiers). This idealized picture shows how an OEM in the first supplier level is supplied by a system manufacturer (Tier 1), whereas the components of a system are ordered from component manufacturers (Tier 2) and their suppliers (Tier 3, etc.).

The demands put on these companies vary, both in the steps of the supply chain, and in the various industry segments. In practice, however, there are many overlaps and intersections between the individual steps. A direct supplier to an OEM for a certain product can still be categorized as Tier 2 or 3 in another product segment. Accordingly, this study adopted this approach, widely accepted in the industry, and complemented it with a qualitative categorization.

To delineate the individual steps of the supply chain, the players belonging to the individual steps of the value chain were identified. Accordingly, in assigning suppliers to the various value-added stages, factors included not only the interrelationships (e.g. direct delivery to an OEM), rather also a supplier’s (integrative) function and the aeronautical responsibility placed on that supplier.
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Figure 4 provides an overview of this system using the example of the partial segment Structural Component Construction.

- **OEM**: Companies with approval to manufacture a particular type of aircraft are considered OEMs.
- **Tier 1 / System manufacturers**: System manufacturers are responsible for development and manufacturing technically complex systems and are also required to adhere to aviation regulations.
- **Tier 2 / Component manufacturers**: Component manufacturers construct component groups ready for installation by system manufacturers or OEMs. They are responsible for the manufacturing process, but not necessarily for component development.
- **Tier 3 / Parts manufacturers**: Parts manufacturers produce parts or components according to the specifications of the component manufacturer ("extended workbench"). These manufacturers have little or no aviation regulations responsibility, but are usually certified to aviation standards.
- **Multi-Tier**: Multi-tier manufacturers supply materials, norm parts or equipment to all levels of the supply chain. This also includes personnel services.

In order to comprehensively assess the company landscape and then consolidate the results, it is necessary to apply this standardization and typification of the industry structure. This was agreed upon by the participating SCE partners and members from the industry during the course of several workshops. After this, a comprehensive survey was conducted with companies operating in Germany.

On the basis of the experience and market knowledge of the SCE partners, and using publicly accessible data, a broad overview of the aerospace companies in Germany was created – this served as the database for the survey. The implementation consortium had access to the clusters and regional associations in the various regions along the value chains – some of them active in this industry for many years. This ensured that the response rate was as high as possible.

The company h&z Unternehmensberatung AG was responsible for technical aspects and programing of the survey.

The survey results were centrally consolidated and analyzed. This included gleaning information from the responses regarding the structure, composition and competitiveness of the German supply chain. Furthermore, qualitative information provided by the companies (e.g. on market challenges, the competition situation or steps for improving the situation) was gathered, compared with the results of other studies and incorporated into the SCE action plan.

Finally, recommendations for action were worked made on how to make the German aerospace supplier industry competitive in the long run and maintain and strengthen its market position as best as possible.

**Survey population**

Over 2,300 companies belonging to the aerospace supplier industry made up the base population of the businesses surveyed, and were compiled prior to the survey (as described in the foregoing) by the implementation consortium nationwide (see Figure 5).

These companies were interviewed by their regional associations or clusters. This approach achieved a 19.5% response rate. The wide inclusion of all suppliers involved in aerospace and a total of 452 responses renders this study representative for the industry, as demonstrated by the number of responses and the thorough coverage of value-added steps (see Figure 6 and Figure 7).

*This study provides the first comprehensive picture of the German aerospace supplier industry.*

The regional distribution of the responses also indicates a representative picture of Germany’s aerospace industry.
Figure 5: Regional distribution of aerospace supply companies in Germany (based on a pre-survey conducted by the SCE Initiative)
Structure of the German aerospace industry

The German aerospace supplier industry comprises over 2,300 companies located throughout Germany. The focus of the industry is both on Northern Germany (especially near Airbus factories), Southern Germany (Lake Constance area, the Munich metropolitan area) and in Central and Eastern Germany (e.g. Berlin-Brandenburg and Saxony-Thuringia). Accordingly, the industry is present not only at the main aircraft manufacturing sites, but also spread out widely throughout the various regions. The aerospace industry as a whole therefore plays an important role in the German industrial landscape.

Regional distribution

The aerospace supplier industry is present in almost all German regions (see Figure 6). The companies were interviewed at each of their sites or plants, in order to gain meaningful information regarding the regional distribution of the industry. This provides a good overview of the diverse German aerospace industry and its large assortment of products and production.

The results show that the aerospace industry is a relevant economic factor in practically all of Germany. These are frequently located in urban centers that naturally have a higher percentage of industry: in Northern German, particularly in the metropolitan areas of Hamburg, Bremen and Hanover; in Central and Eastern Germany in the greater Berlin/Brandenburg and Dresden areas; in Southern Germany in the Munich, Stuttgart and Lake Constance regions; and in Western Germany in the metropolitan areas of Aachen, Bonn and Cologne. This distribution is reflected in the number of responses for the individual regions (see Figure 7).

Germany has a diverse, heterogeneous supplier landscape.

The main concentrations are located around the historically rooted sites of the aircraft manufacturers, who are distributed throughout all of Germany. These
Company size and number of employees

A total of 108,000 individuals are currently employed in aerospace in Germany. This is the highest number ever in Germany. Revenues overall for the industry was €37.5 billion.

The survey results clearly indicate that the supplier industry in Germany is strongly oriented to small and medium-sized enterprises. The majority of companies included in the survey can be categorized as SMEs (small and medium-sized enterprises).

Figure 8: Number of companies according to revenue

More than 76% of the companies responding reported annual revenue of less than €10 million annually (see Figure 8) and are thereby classified as SMEs. Also regarding the number of employees they fall into this category. More than 90% of the aerospace companies employed less than 250 employees (see Figure 9).

Figure 9: Number of companies according to number of employees

A large number of the companies surveyed are also active in other sectors besides aerospace. Because the aerospace industry is a niche market for many of these companies, the number of employees engaged in aerospace at many of the SMEs often resembles a small company in itself (see Figure 9), even if the company has more employees overall. In particular, small and medium-sized companies with over 100 employees are often linked with other very small entities in other sectors.

The aerospace industry is marked by the interaction between large international manufacturers, Tier 1 suppliers and many mid-sized, small and even very small and often very specialized suppliers.

This company size structure presents a particular challenge to the German aerospace industry. On the one hand, it is important that the companies maintain their competitive position and on the other hand, that a diverse supplier continues to develop.

When comparing the company structure in Germany with the expectations of international market participants for their supply chains, there is a clear need for more structural adaptation. Projections of revenue trends of these companies for the next few years are very positive throughout the industry. If the industry succeeds in completing the aforementioned structural transformation, the majority of companies surveyed see significant market potential for their business (see Figure 10). With regular growth rates of over 5% annually, the aerospace industry is currently one of the fastest growing sectors in Germany. At the same time, the aerospace industry also has very steady revenue streams, and therefore provides SMEs in particular the possibility to compensate for

1 Source: Industry Figures of the German Aerospace Industry 2016 (BDLI);
Note: In contrast to the BDLI annual statistics taken at the same time, the SCE survey only looks at the aerospace industry (without air travel and space travel), however it also includes those value-added steps not directly involved in aircraft construction (for example, mechanical and plant engineering).
2 Definition of SMEs according to the European Commission: <250 employees; maximum annual revenues of €50 million; and maximum total assets of €43 million.
economic fluctuations, such as those occurring in the automotive industry.

The majority of companies surveyed painted a positive picture for long-term business development.

In the mid- and long term in particular, suppliers project increasing revenues in aerospace business. Only a small number of those surveyed expected declining revenues (see Figure 10).

When looking at available capabilities in the German aerospace supplier industry, the companies cover nearly the entire range of production segments relevant to the industry. The study requested responses for separate categories: manufacturing, materials and service competencies.

The supplier landscape is particularly strong in manufacturing. The value chain spans from development (Engineering) to assembly capabilities, and on to various materials processing techniques (see Figure 11). This indicates the strong emphasis in Germany on manufacturing processes, among other things. On the other hand, assembly also plays a big role in service capabilities.

Additive manufacturing methods, which show great promise for the aerospace industry, have already been introduced in some companies and are used fairly frequently in combination with other techniques such as bonding, welding and riveting (see Figure 11).

In the area of material-related competencies, the German supplier industry predominantly processes traditional materials for Structural Component Construction. Composite materials, which have seen use only relatively recently, have become widespread in the industry and are firmly established in the supplier industry (see Figure 12).
With a view to service competencies, the value chain is strongly oriented to aircraft manufacturing, as mentioned previously, yet is still very diverse. Services such as Testing, Simulation and Assembly are core competencies among German suppliers. The large share in R&D in the German aerospace supply chain is reflected by the importance of the Testing and Simulation segments. Maintenance is also important in the supplier industry (see Figure 13).

For many companies in the aerospace supply chain, in addition to basic business and technological capability, certification and licensing are essential for good positioning in the market. Without certification, it is impossible to achieve growth and a stable position in the value chain.

For suppliers at all steps of the value chain, certification to the ISO/EN 9100 standard or also manufacturer-related standards such as Airbus approval as a QSF-A, -B or -C supplier are an important entry ticket to the supplier market and an indication of quality within the value chain. For suppliers on higher levels of the value chain additional aerospace certifications such as EASA 21G or 21J for manufacturing or research companies are especially important. Analogous to the large number of small and medium-sized companies, the basic ISO 9100 standard is already more prevalent than certifications to EASA standards. This is an indication that assisting the process of structural change will require more effort, in particular in attaining the more difficult EASA certifications (see Figure 14). The same applies for companies in the maintenance sector regarding the EASA Part 145/147 standard.

A large number of the companies surveyed mentioned that there was room for improvement in the area of certification. This includes both the entry certification ISO 9100 (especially the renewal of these certifications) and the EASA or manufacturer-related approvals required for achieving a higher value-added step.

*Companies see room for improvement regarding certification.*

The large number of certifications that companies apply for demonstrates their willingness to become more active in this area and actively work on their own competitiveness by acquiring such qualifications.
Structure of the value chain

Germany has a very diverse value chain in nearly all segments of the aerospace industry (see Figures 16 and 17). However, the current structure of the value chain does not yet correspond completely to the tier-level structure of the OEMs and Tier 1 companies as already described (see Figure 15). The ideal structure of the supply chain, as propagated especially by OEMs and large systems companies, does not exist at the supply levels 2-4, in particular.

Most companies are components (Tier 2) and parts suppliers (Tier 3), whereas a small number of suppliers are found at the level of system suppliers (Tier 1) (see Figure 16).

**Most companies are components and parts suppliers.**

Correspondingly, the German aerospace supplier industry is strongly represented by companies at the Tier 2 and Tier 3 levels. This segment is particularly affected by structural change and is experiencing widespread consolidation trends. Notably the large Tier 1 systems suppliers are currently adapting their supplier chains to commissioning integrated work packages which are awarded less often, but with large volumes, to components suppliers. The purpose behind this is to reduce the number of direct suppliers – that is, fewer Tier 1 and Tier 2 suppliers in the supply chain – who however then have larger tasks than previously.

Component suppliers especially will benefit from market opportunities due to growing contract volumes. On the other hand, international competition is getting keener. Increased contract consolidation poses a challenge to existing supplier interrelationships.

The goal of this consolidation is to reduce the number of suppliers to systems companies. This is in contrast to the large number of Tier 2 suppliers in Germany, and should therefore be regarded as indicator for potential consolidation tendencies in the supply chain going forward.

In Germany, most companies are still categorized as Tier 2 and Tier 3 (see Figure 16). At the same time however, the German supplier industry is dominated by SMEs, as described in the foregoing – also at the Tier 2 level.
These companies often do not have the necessary resources and prerequisites for meeting the new requirements.

## Core competencies / Industry segmentation

The results of the survey confirm the general perception that there is a concentration of companies of a certain sub-segment of the industry. In all segments, however, Germany has a distinct and nearly complete supply chain.

The largest sub-segment in numbers of companies in the value chain is in the area of Engineering/Testing/Qualification/Documentation/Research (see Figure 17). Other important segments are Cabins, Systems and Structural Component Construction.

In all of the segments involved in the survey, the supplier structure is quite diverse. In particular, the middle steps of the value chain (suppliers of components and parts) contain the most companies in all segments.

**Germany is a strong partner in all areas of the supplier industry.**

At the same time, there is a relatively large number of companies operating as Tier 1 suppliers. This too will probably change as the supply chain continues to be consolidated. At the same time, it is important to note that all segments of the aerospace industry are strongly represented. Overall, there is a close relationship between the individual segments and the respective OEMs or Tier 1 company locations (see Figure 19). This also demonstrates the nationwide presence of the aerospace industry.

The situation is similar for other industry segments. The centers for Structural Component Construction are located in the vicinity of Airbus plants and other large companies, for example in the Hamburg metropolitan area, with factories in Stade, Buxtehude and Hamburg; the metropolitan region Bremen-Oldenburg with factories in Bremen; the Premium AEROTEC plants in Nordenham, Varel and Bremen; the metropolitan areas of Munich and Augsburg; and the Lake Constance area.

In the area of Engines, suppliers are located near Rolls Royce in the greater Berlin-Brandenburg area, in the vicinity of MTU Aero Engines in Munich and MTU Maintenance in Hamburg and Berlin, as well as close to Lufthansa Technik in Hamburg. These areas are also strong in the MRO segments (see Figure 19).

This is especially apparent in the Cabin area. The Hamburg Airbus factory is focused on cabin interiors, which has led to a strong concentration of suppliers in this segment in the greater Hamburg area.

**The supplier structure is oriented to the production sites of the OEMs and Tier 1 companies.**

Engineering is focused on three regions – Southern Germany, Northern Germany and Eastern Germany – whereas Plant Engineering and Jigs & Tools are clearly concentrated in the north and northeast areas of Germany.
The strongest geographic concentration is found in the Maintenance/Repair/Modification segment (MRO) (see Figure 18), with clear tendencies toward airports.

These suppliers are mainly located in Hamburg (Lufthansa Technik), Hannover (MTU Maintenance, TUlfly), Berlin-Brandenburg (Lufthansa-Bombardier, MTU Maintenance), Dresden (DHL, Elbe Flugzeugwerke), Friedrichshafen (Zeppelin, Liebherr, and others) as well as in Frankfurt, an aviation hub (e.g. Lufthansa Technik).
Changes in the value chain structure

In addition to describing their position within the supplier industry structure, the study also asked the companies about their projections for future trends and positioning of their companies. This provides an indication of the expected changes within the supply chain.

In general, it is evident that the majority of suppliers are striving to reach the next highest Tier.

There is a trend among the companies toward advancing to higher Tier levels.

This affects in particular the middle steps of the value chain. The proportion of OEM companies and so-called multi-tier companies (supplying several steps of the value chain) is largely unchanged. However, the share of companies aiming at reaching Tier 1 and Tier 2 in five years is growing, whereas the number of companies that see themselves at Tier 3 is declining considerably (see Figure 20). The proportion of companies that defined themselves as Tier 3 in 2021 is accordingly 13% lower than in 2016.

This development is probably a response to OEM plans to consolidate their suppliers – some already realized. Many companies are planning to take an active role in this process and to position themselves at higher Tier levels (see Figure 21).

However, it is important to note that the absolute number of Tier 2 suppliers will likely drop rather than increase, because systems companies will reduce the number of their direct suppliers. As a result, we can assume that there will be intense competition and consequently, significant consolidation within the supply chain.

If we consider the changes taking place within the various industry segments, we see that they are at different stages of the consolidation process.

There has been relatively little change in the MRO, Engineering and Engines segments. These segments have already undergone considerable consolidation. In the Engineering area, however, it is evident that there is intensive competition among suppliers for Tier 1 positions (see Figure 21).

The progress of the consolidation process varies greatly among the segments.

However, especially in Structural Component Construction, Cabins and Systems – the segments with the greatest number of companies affected by consolidation – there are strong signs that this process will gain speed. Companies in all three areas generally expect to move from Tier 3 to Tier 2 suppliers (see Figure 21).

At the Tier 1 supplier level, this is less evident. Whereas in the Engines and Cabins segments the proportion of Tier 1 suppliers is declining, an increasing number of Structural Component Construction and Engineering companies plan to move up to this level, increasing their share.

Figure 20: Company self-assessments of their position in the supply chain in 2016 and 2021
In the area of Plant Engineering, a different trend is apparent. On the one hand, some companies also plan to “advance” to the level of Tier 1 supplier. On the other hand, at the lower levels of the value chain the proportion of Tier 2 suppliers is declining, whereas the proportion of Tier 3 suppliers is increasing. Accordingly, there are two parallel processes taking place within the value chain: consolidation and specialization.

Overall, the respondents’ projections of their positioning in five years varied more than their self-assessments of their current positioning. The higher overall number of responses to the question on positioning in five years could be an indication of continued diversification of companies. Companies currently active in only one industry segment (e.g. Cabins) plan to branch out into other areas (e.g. Systems, Structural Component Construction). The share of suppliers in the Systems segment is growing relatively fast, for example.

In the coming years, we can expect both continuing consolidation of the absolute numbers of aerospace companies – in particular at the higher Tier levels – and stronger industry diversification.

Industry structure

Program participation
The German aerospace industry is traditionally strongly interlinked with the Airbus Group. Both in civil aviation and in military aircraft, Airbus is the biggest customer for the German aerospace supplier industry.

However, this study shows that, with increasing internationalization and industrialization of supply chains, a growing number of companies is participating in programs of other manufacturers (see Figure 22).

Suppliers have strong ties to Airbus, yet there is an unmistakable trend toward internationalization.

The largest number of German suppliers are involved in various Narrow Body programs, with a strong presence in those of Boeing, Embraer, Bombardier and COMAC. Participation in Wide-Body aircraft programs is much less international.

Participation in programs of the Regional and Business Aviation segments is particularly heterogeneous, with Germany represented in a wide variety of aircraft programs. At the same time, it is important to note that the response rate in this segment was quite high among OEM companies. In
the General and Business Aviation areas in particular, Germany possesses the capabilities for developing and manufacturing entire aircraft.

**Germany possesses capabilities in Regional and Business Aviation.**

In the area of military programs, regional value chains are especially important. This is evident in the numbers of German suppliers participating in these areas. European programs dominate, particularly those in which Airbus is the main actor. Germany’s active role in the A400M program, for example, is reflected in the strong dominance of German suppliers. This program is currently the largest procurement program in Germany, which further strengthens this trend. The A400M program currently engages more supplier companies than any other military program.

**Customer relations**

The strong presence of German suppliers in Airbus programs means that their most important customer relationships are found in the Airbus supply chain. The Airbus Group is the most important customer for German suppliers (see Figure 23).

In addition, it is apparent that – regardless of participation in the various programs – the large German Tier 1 companies comprise the largest customer group.

The companies mentioned most frequently are Diehl-Gruppe (Cabins and Systems), Premium AEROTEC (Structural Component Construction), Liebherr Aerospace (Systems), Lufthansa Technik (MRO), and Rolls Royce and MTU (Engines).

**Most direct customer relationships are between suppliers and German Tier 1 companies.**

This illustrates the importance of systems companies in all industry segments for the German supplier industry. They provide business for the downstream value chain and thereby ensure additional value added, not only for their own companies but also for their German suppliers, thereby strengthening the German aerospace industry.

At the same time, there are already numerous international companies among the top customers. This includes in particular those international OEM and Tier 1 companies that have their own production sites or subsidiaries in Germany (Rolls Royce, for example). This is additional evidence for the important role of integrators for the downstream value chain in Germany.

It is important to emphasize the strong links to non-German manufacturers, such as Boeing, Embraer, Bombardier and COMAC. These OEMs – traditionally the competition for European manufacturers – have already started to create supply chains in Germany, which in turn provide a basis for additional R&D.
The German supply chain now conducts business with numerous non-European manufacturers.

Another important customer is the Bundeswehr (the Federal Armed Forces). Procurement policy of the military provides additional impulses for R&D programs at German systems companies and integrators.

German suppliers also mentioned OHB Systems, a space travel company, as an important customer – even though the study explicitly avoided any emphasis on space travel. Accordingly, there is a definite connection between the aviation and space industries.

Related industries include in particular medical technology, measurement and control technology and industrial electronics and energy. This underlines the enormous economic significance of the aerospace industry due to its role as a driver of technology.

Networks with other industries ensure that the aerospace industry is buffered against economic downswings and industry risks. This enables SMEs in particular to develop greater independence and robustness.

And lastly, intensified technology transfer benefits both sides – for example in the scope of Industry 4.0, or in developing and introducing new materials.
Internationalization

The greatest challenge facing companies in global competition is positioning themselves to survive structural change. The study results show that German aerospace companies are already intensifying their international approach regarding manufacturing and also procurement and cooperation. Germany companies are located in practically all regions of the globe.

The most important foreign locations for German aerospace companies are currently the USA, followed by France and Eastern and Southeastern Europe. China is by far the most important area in Asia. This is an indication that German aerospace suppliers have already made big strides in internationalizing their production.

However, marketing is still largely concentrated on Europe. As reflected in customer relationships, Germany remains the most important sales market for large parts of the German supplier industry (see Figure 26). This leads to the conclusion that German suppliers pursue internationalization mainly in the scope of existing customer relationships.

**Internationalization of customer relationships is a significant challenge for German suppliers.**

As an example, globalization has lead Airbus, the largest European aerospace corporation, to use international supply chains to an increasing degree. This has driven internationalization at the Tier 1 level. German suppliers have followed these customers with their manufacturing activities.

Internationalization – driven by sales activities to attract new non-European customers – is still in the beginning phases. It will be the main challenge to suppliers in in their efforts to maintain a competitive position as self-sufficient players in the international market.

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Figure 24: Industry networks of the German aerospace supplier industry
The sole non-European market of any importance for sales is the USA (see Figure 26), which is also relevant as a procurement market for German companies. Survey respondents mentioned the USA twice as often as France as an important procurement market. 

Companies are accelerating their internationalization efforts, particularly in Europe.

China’s role varies, depending on the various motivations for internationalization. According to the companies interviewed, China is exceptionally important in the area of manufacturing, whereas its role in sales and procurement is not as significant compared with the rest of Asia.

Overall, German industry follows its customers to international target markets. Nevertheless, the companies interviewed identify Germany and neighboring countries as the most important markets by far – both currently and in the future. The key role played by Austria and Switzerland is primarily due to language.

More effort is necessary to expand into international markets, a huge challenge for aerospace companies – particularly for those below the Tier 1 level.
The study shows how strongly the German aerospace industry is affected by structural change, which has already reached an advanced stage within the supply chains. Consolidation benefits large companies with large capital reserves and is difficult for small and medium-sized suppliers. SMEs must therefore actively position themselves in the market in order to remain competitive internationally.

Structural change in the aerospace industry

The results of the survey show that structural change in the German aerospace supplier industry is already quite advanced in some areas. However, there are large differences in how far this change has progressed in various sub-segments of the industry.

Creating systems companies was an important step for the German aerospace supplier industry.

The study shows that Tier 1 suppliers in particular have made progress in creating systems companies with accompanying overall competencies and a critical economic size, ultimately as a result of government and industry initiatives. One example is the German Aerospace Industries Association which assisted in the process of creating large systems companies in Engineering and Cabins. Founding Premium AEROTEC, the largest German Structural Component Construction company, was also an important step toward creating an international integrator (Tier 1) in this segment. This step also had a big effect on downstream value chains.

At the same time, this process is not yet finished. In particular, the areas of Mechanical and Plant Engineering, Structural Component Construction and Engineering, Testing, Qualification and Research are expected to make additional steps toward creating large systems companies.

Currently, the strongest pressure to consolidate is felt particularly on the Tier 2 and Tier 3 supplier levels. The segments Structural Component Construction, Cabins and Systems are the focus of these efforts.

The creation of Premium AEROTEC GmbH has provided an important impetus to consolidation in the Structural Component Construction area. Whether additional German Structural Component companies are successful in establishing themselves as Tier 1 suppliers remains to be seen. Due to the large share of German aircraft programs in Structural Component Construction, it will be important to have a number of strong companies that are capable of integrating smaller firms into the value chains in the long term.

The survey shows that also at the Tier 2 level the consolidation process is expected to accelerate. The companies interviewed stated that they intended to increase efforts to move up from Tier 3 to Tier 2 suppliers (see Figure 21).

Pressure to consolidate is felt by Tier 2 and Tier 3 suppliers.

Cabin suppliers are taking a similar route – here, too, consolidation has started at the Tier 1 level. The companies surveyed expect this trend to also encompass the Tier 2 and 3 levels.

In the Systems area, the German supply chain already comprises multi-system capable Tier 1 suppliers that play a significant role for the downstream value chain. Further consolidation is expected in the Tier 2 and Tier 3 areas as well.

This trend is already apparent in the Engines segment, yet the firms surveyed expect somewhat less rapid changes in the Tier levels.

Overall, it is essential for the German aviation industry to continually forge ahead in anchoring all steps of the value chain on the global level, in order to avoid being dependent on a small number of companies for orders.
Competition and market potential

Internationalizing the aerospace industry will provide great potential for growth. However, pressure from competitors is also being felt in global value chains. In the past few years, new competitors have appeared in so-called best-cost-countries, challenging traditional supply chains to a certain degree.

Firms wishing to achieve long-term success at Tier 1 or Tier 2 levels of the supply chain must also be able to survive in this global competition. However, the affected companies have greatly varying perceptions regarding some of the individual target markets (see Figure 27). It is not surprising that those target markets offering the greatest potential for German suppliers are also seen as the biggest competitors on the global market.

France and the USA are perceived as especially strong potential competition (see Figure 27). At the same time, both of these countries offer the greatest sales potential. Far behind them follow the UK, other European countries and Asia and China. German suppliers currently see their greatest potential in the rest of Europe. Here the sales potential is seen as high, whereas potential for competition in these regions is perceived as relatively low.

The European market offers the greatest market potential for German suppliers.

Respondents also perceive market potential in Asia as positive, yet still significantly behind North America. It is interesting that Chinese competitors are apparently perceived as a greater risk than other competitors in the rest of Asia. Conversely, the potential for sales in China is estimated to be lower than in the rest of Asia.

![Figure 27: Assessment of sales and competition potential for German suppliers in international target markets](image)

Competitive capability

The German aerospace industry is traditionally in the lead, in particular due to its technological competitiveness. This position is counteracted by cost disadvantages. However, to maintain a good position in the market, global competitiveness of the supply chain is imperative. As the supply chain is restructured, technological aspects and other factors as well gain importance in realigning companies.

Companies that wish to establish themselves as systems suppliers to the aerospace industry over the long term must be able to manage comprehensive projects together with the OEMs. This includes both an international manufacturing and supplier network, sufficient financial and industry-specific independence, the ability to take on risks or react quickly to disruptions in production processes or in
Supply chain restructuring poses multiple challenges to the companies involved in those supply chains. Continuing structural change is creating massive changes to the industry. In order to emerge from this process in a stronger position, the companies must actively position themselves in the market. According to the companies surveyed, consolidation matters play a particularly large role.

Companies must act (instead of reacting) in order to remain competitive in the long term.

Companies will need to re-align their business models as re-positioning within the value chain takes place – for example the transformation of parts suppliers into components suppliers, or extended workbenches into risk-sharing partners.

Future challenges
As a result, companies must strengthen their international approach. Due to their still predominantly SME-structure, this is frequently only possible by means of strong cooperations between suppliers as well as along the value chain.

Interviewees mentioned the process of internationalization, rewriting business models and creating cooperations as the greatest challenges (see Figure 29). This confirms the need for action to assist the industry in its response to structural change in the supplier industry.

Companies are taking on their biggest challenge: strategic positioning in the supply chain.

The fact that many players within the supply chain are actively accepting this challenge is demonstrated by the measures described in the foregoing that companies are taking to change their position in the value chain.

This includes both improvements in industrial manufacturing capabilities and expansion of management resources for setting up and developing the company’s own supply chain. Among other things, the significant increase in certifications shows that the companies have basically accepted the challenges described here.

It is the task of all members of the Supply Chain Excellence Initiative to assist these companies to the best of their ability, with primary emphasis on integrating the specific outcomes of the survey into future efforts, as well as taking measures to provide support to the German aerospace supplier industry.

This will enable not only the aerospace industry but also Germany as an industrial location to achieve a sustainable position in global competition.
Outlook

The analysis of the industry structure demonstrates the breadth and depth of the German aerospace supplier industry. German suppliers show a strong presence in nearly all sub-segments of the industry. At the same time, however, they are faced with big challenges that they must manage, in order to remain competitive in the face of the structural changes taking place. However, large sections of the aerospace supplier industry do not have the structure to deal with the demands of international competition. The German aerospace supplier industry has already made efforts to push this transformation process, yet in the areas of consolidation, industrialization and internationalization there is still quite a bit of room for improvement. The Supply Chain Excellence Initiative has therefore developed a program to assist companies in aligning themselves with changing markets and to enhance the competitiveness of the German aerospace industry.

Restructuring in the aerospace supply chains is gaining speed. As aircraft manufacturing becomes increasingly industrialized, Airbus and Boeing in particular have started consolidating the industry, with the goal of creating large system suppliers, which in turn aim to consolidate supply chains in downstream value-added steps.

This study shows that the not all German companies are currently prepared, regarding size, capabilities and resources. Most companies can be categorized as SMEs (small and medium-sized enterprises); the majority of suppliers have less than 25 employees. In many segments there are no companies that can assume the new role of integrator within the supply chain. Assisting in this process would help strengthen the entire supply chain.

The areas requiring the most action are at the Tier 2 supplier level. In past years, system companies were created at the Tier 1 level in Germany, with the assistance of associations and clusters. Today, Germany has Tier 1 suppliers in practically all industry segments. This process should be continued and expanded to the subordinate steps of the value chain. The Tier 1 level needs strategic partners that can supply entire ranges of parts or component groups. Converting suppliers from companies that simply fill out orders as an extended workbench to independent parts and component suppliers should therefore be the primary focus of the Supply Chain Excellence Initiative. Many suppliers have already recognized this challenge and are moving forward.

As described in the foregoing, there is a clear trend of many Tier 2 and 3 suppliers to develop their business toward higher levels of the value chain. Approximately 200-250 companies in Germany are affected by this process. However, it is also clear that this cannot be achieved by all of the companies, rather that additional consolidation of the number of suppliers will take place.

The challenges of this process are the following:

- Continued diversification of customer structure
  Value chains are becoming international. The German aerospace supplier industry however is still very strongly oriented toward European manufacturers.

  Germany’s presence of international Tier 1 suppliers is not strong enough. Direct customer relationships are found most frequently between suppliers and German Tier 1 companies, or with Airbus or international partners located in Germany.

  Not only aircraft manufacturers but also Tier 1 suppliers should increase their international outreach as customers. This approach entails the following goals:

  -> Better anchoring of German suppliers (especially Tier 2) with Tier 1 international companies

  -> Expanding the presence of international suppliers in Germany by actively encouraging them to do business here

  -> Better anchoring of the international companies already located in Germany in the German aerospace communities

  -> Expansion of German presence in international growth markets

Embracing and actively participating in the consolidation of the business landscape
Consolidation within the supply chain is visible everywhere on the globe – and ultimately, a trend in creating cooperations and in mergers and acquisitions. Consolidation has already progressed to
a great degree in the Engines, Engineering and MRO industry segments. Pressure to consolidate is particularly felt in the areas of Structural Component Construction, Cabins and Systems.

Especially at the Tier 2 and Tier 3 levels suppliers will likely make extensive modifications to their business models. There are not enough internationally competitive Tier 2 suppliers in the German supplier industry that could become contractors for small and medium-sized companies.

Goals in organizing consolidation efforts should include:

- Developing cooperations that also allow owner-managed suppliers to move to higher value-added levels
- Promoting international and transnational partnerships
- Providing information on risks, opportunities and options in financing business growth strategies
- Using existing industry networks (especially in the areas of Plant Engineering and Automotive) for positioning in the global market
- Developing new business models within cooperative company associations (e.g. in the scope of Industry 4.0)

**Strengthening the ability to take on program responsibility**

In general, it is apparent that companies are taking on their biggest challenge: strategic positioning in the supply chain. Whereas German companies are strong in the area of innovation, their ability and willingness to take on program risks are below average. However, the latter will continue to become more important in the future because procurement will be linked not only to technological and capacity capabilities, but also to accepting program risks. This requires action.

Yet at the same time, the innovative strength of German suppliers ensures that OEMs and Tier 1 companies are firmly positioned in international markets. There must be suitable solutions for supplementing technological strength with a greater ability to participate in developing programs. The following areas should be emphasized:

- Encouraging the diversification of business models (e.g. pooling management competencies, getting companies to expand their own sourcing activities to the international level, using flexible methods)
- Developing methods for reasonable and SME-oriented distribution of program risks
- Improving and expanding information on financing options, as well as assisting in implementing new financing models within companies
- Minimizing program risks by improving cross-company communication and program planning

**Improving industrial productivity along the supply chain to remain competitive in the face of competition from aspiring new aerospace regions**

German suppliers possess extensive manufacturing and materials capabilities. Strong growth rates in manufacturing require improvements in quality and productivity, in particular. It is necessary to instigate measures to secure and improve production processes:

- Supporting companies’ efforts to attain certifications, which are essential for entering markets at higher Tiers
- Introducing modern manufacturing processes to SMEs (e.g. digitalization and Industry 4.0)
- Further development of Tier 3 companies to secure production capacity in the long term in Germany (for example by introducing modern manufacturing methods (LEAN) in small and medium-sized enterprises)
- Supporting and consulting SMEs on improving their processes
- Assisting in the digitalization process along the value chain

**Enlarging cooperation models in the supply chain**

The German supply chain is very fragmented compared to the ideal, and comprises many owner-managed businesses. In order for these companies to be able to compete in large tenders and international contracting, more cooperations are required within the supply chain if this structure is to survive.
A promising approach is to develop vertical and horizontal cooperations to maintain value-added, even with relatively small companies prevalent in Germany. The proper conditions must be created:

- Developing suitable cooperation models, which primarily focus on owner-managed companies, along with their needs and strengths
- Improving transparency of the available supply chains in order to create impetus for cooperation

Implementation strategy

These efforts to improve the market situation of the German aerospace supplier industry can only be accomplished when all relevant players in Germany act together. The Supply Chain Excellence Initiative is a joint initiative of German aerospace industry associations with the aim of moderating these various activities. To get the German aerospace industry on the right track, it is necessary to coordinate and consolidate efforts of industry and the Federal Government and the Länder. In doing so it is important that players in business, associations and government move together – only when these three stakeholder groups work together can the desired result be achieved. The Supply Chain Excellence Initiative is a suitable platform for this approach.

The SCE Initiative is a Federal platform for implementing changes required to prepare the German aerospace supplier industry for the future.

The work has been divided up among the participating associations, clusters and initiatives into six various areas, each with a program of activities for specific assistance of the companies. The SCE partners receive assistance from associated members in the industry (see Figure 30).

It is now important to provide these activities – already planned and to a certain extent in the full stages of implementation – with a strategy process common to all work areas that will be the blueprint for the future direction of these activities at the Federal level. The Supply Chain Excellence Initiative invites all participating members from the industry, associations, the Federal Government and the Länder.
to contribute to these efforts, in order to ensure that the Initiative is sustainable, and has a broad, national footing.

Beside this, financing for the individual implementation measures must be secured on a long-term basis, and stepped up beyond current levels. This is the only way to achieve the breadth needed to reach the entire value chain in Germany. All participating members are requested to contribute, in order to secure this financial security. To this end, a joint financing framework consisting of the Federal Government, the Länder, the industry and associations should be created, with respective shares in bearing the costs for the tasks as they are incurred.

The goal is to enable (further) development of the measures recommended below, to provide the necessary resources for the SCE Initiative, and in particular, to ensure broad implementation in the companies concerned.

**Action plan**

Building on the results of this study, the partners of the Supply Chain Excellence Initiative have developed an extensive action plan in the course of numerous meetings, workshops and work groups, as well as in individual discussions with representatives from all levels of the aerospace supplier industry. The specific measures were grouped into six topics, offering the participating companies optimal customized assistance in positioning themselves for structural change and global competition of the aerospace industry (see Figure 31).

Figure 31: Overview of the action plan for the Supply Chain Excellence Initiative
**Business Models**

In order to best assist suppliers in selecting and developing their business models, the Initiative sponsors workshops and individual events that use practical examples to identify challenges and business potential against the backdrop of role models in the supply chain. The goal is to sensitize companies to this topic and to support them in identifying gaps in their competence and opportunities for improvement, which are then specifically developed in individual projects for analyzing business models.

To help in this process, a Quick-check should be created, for categorizing the competitiveness of the companies under certain business models, and then rolled out nationwide. This will point out specific measures for developing a business model, which can then be implemented together with that company. This Quick-check will consolidate the various level of industrial maturity models for performance already used in the industry into a practical model oriented toward the SME-nature of the industry, in order to initiate a specific positioning process.

In order to implement the planned activities, it is necessary to provide sufficient resources, in particular for conducting Quick-check, as well as for specific implementation in the company. For fleshing out the details, industry must also be directly involved in formulating the requirements for future business models.

**Internationalization**

A major goal of the drive to internationalize the German aerospace supplier industry is to better anchor the supply chain in international value chains. A prerequisite for this is sufficient availability of relevant market data.

The action plan is aimed at providing assistance in this aspect. Analysis data is collected and provided to the companies for identifying relevant international target regions. Extensive data analysis can provide specific options on how to enter the market. These considerations help in in preparing and conducting business acquisition trips in the various target regions. An important element in achieving this is the already well developed network of direct cooperation relationships between the various members of the Supply Chain Excellence Initiative.

This is accompanied by regular informational events and business workshops on various internationalization topics, such as private international law regulations, market entry or business opportunities in the target markets.

Additional support is especially important for expanding suppliers’ portfolios as well as for rolling out the action plan nationwide.

**Industrial Performance**

The Initiative conducts projects with SMEs to enhance industrial performance in the supplier industry.

Aerospace industry experts analyze the situation in the individual SMEs, to derive specific recommendations for improvement (e.g. new or improved manufacturing methods and processes). The analysis is rooted in a level of industrial maturity model for performance that was developed by SPACE Deutschland and made available to the SCE Initiative. This model is already being implemented successfully in other European countries.

In the next step, the measures are then implemented in the companies, accompanied by training sessions offered either as company-specific sessions or in groups. Topics include Lean, Visual Management, MRP2, 5S, Problem Solving and set-up time optimization.

The SPACE level of industrial maturity model also aims to develop aerospace-specific industry solutions and thereby include topics on digitalization and Industry 4.0. This entails close cooperation between the Business Model and Sales & Operational Planning areas.

These activities are accompanied by events and information exchange between companies – especially SMEs – on new manufacturing methods (e.g. 3D printing, robotics, etc.) as well as specific assistance for suppliers in certification, quality management and quality assurance.

The goal is to assist as much of the supply chain as possible. For this comprehensive approach it is necessary to specifically finance all regions, for example using “Consulting Vouchers” or by similar means.

**Financing & Contracts**

Companies that wish to actively position themselves in the supply chain require adequate financing for their plans. The increasing differentiation of tasks within the supply chain, particularly those taken on by Tier 2 companies, also requires contractual
adjustments in order for improved business models to function.

Work done to prepare for the companies for this new situation has revealed that they are not adequately informed regarding financing options. A modular system that can be used nationwide has been created to fill this gap with informational events, consulting services and opportunities for exchanging knowledge and experience.

Information is provided regarding available financial instruments, and in addition, successful best-practice examples of knowledge transfer between companies. The companies provide feedback that also contributes to expanding the available means of funding. One example is the discussion on further development of the Aircraft supplier scheme of the Federal Government (Luftfahrzeug-ausrüsterprogramm), an important component in assistance for the supplier industry that provides great potential for efficient funding, also for developing new areas of business for the supplier industry.

The goal must be to adjust available NRC-financing accordingly so that it provides optimal support for expanding the market potential for German suppliers to other markets and customers.

Sales & Operational Planning
A competitive supply chain requires functioning planning and communication systems. The prime goal of Sales & Operational Planning is therefore to strengthen the capability of Supply Chain Management to develop overall harmonized and digitalized planning and order processing procedures.

To this end, a Leadership and Supply Chain Management Training Plan was created and tested on selected companies. This qualification training program enables supply chain managers and procurement and logistics departments to utilize cross-company systems and to develop them in order to assure transparency.

Other goals of this work area are digitalization of the corresponding planning processes and standardization of the interfaces required.

The eTools available on the market for these work areas are compared and presented to the companies in a neutral overview. The goal is to provide SMEs with a better overview of possibilities for digitalization in their own companies. In addition, there are workshops in the planning that should serve to determine what assistance SMEs require for applying an eTool and how to participate in developing eTools. At the same time, opportunities for standardizing interfaces are being explored, in order to make the individual software systems more compatible and thereby facilitate cross-company planning systems as proposed by the Industry 4.0 approach.

Cooperations
Suppliers who take on complete packages must often significantly expand their range of services in order to be able to keep up internationally. SMEs in particular cannot always maintain this variety of services, and so cooperations between companies have gained in popularity. The action plan in the Cooperations work area provides specific services for initiating, designing and implementing such company cooperations.

A workshop program was developed for assisting cooperations in all phases, from inception to implementation. This includes creating a cooperations coordinate system with various cooperation models and topics for potential cooperation activities. In the course of a cooperation simulation, a preliminary test of the cooperation is run with a focus on various requirements (“proof of concept”), for improving the chances of success of the cooperation.

The Supply Chain Excellence Initiative partners also provide assistance to companies looking for suitable cooperation partners. In order to get a possible cooperation to work, in addition to active support from all national partners, it is also particularly important to actively involve prospective customers. In particular, Tier 1 companies must put together packages that allow the advantages of cooperations to take effect and, as potential customers, assist in creating cooperations and factor them into their procurement policies. Funding and assisting company cooperations and the necessary networks would be very beneficial – not only for pursuing innovation but also for industrial and production-friendly cooperation entities.

Primary activities of the SCE Initiative
The SCE Initiative has taken on the task of developing and strengthening the German supplier industry in a nationwide effort. In order to evaluate the results of the activities described in this study and their effect
on positioning of the supply chain, the Initiative suggests introducing a uniform set of Key Performance Indicators for measuring its success. This includes measuring direct results of the activities and also regularly assessing the status quo of the German aerospace supplier industry, in order to quantify the desired effects.

This study can serve as a basis for introducing regular structural monitoring of the German aerospace supplier industry, which will quantify the changes in the supply chain over several years. In addition, the companies should be surveyed across all work areas of the Initiative, regarding their wishes and suggestions on further development of the Initiative, in order to ensure that it is in step with the market and that funding is used optimally.

Required action on the part of business, government and associations

The German aerospace supplier industry is faced with far-reaching changes in its company structure and industrial structure. The industrialization and internationalization drive in the industry is at once an opportunity for and a danger to the German aerospace industry. The Supply Chain Excellence Initiative has taken on the task of actively participating in this structural change and assisting the companies as much as possible with regard to their individual needs, so that they remain competitive in the long term.

This however can only succeed if all participants work together toward repositioning the supplier industry. This applies to the industry at all levels of the supply chain, Federal and Länder policy, and to associations, clusters and initiatives assisting companies at the local level.

The Supply Chain Excellence Initiative recommends that the following action be taken quickly:

Action required on the part of the industry
- Active, focused participation in developing and implementing activities, specifically defining requirements (e.g. industrial level of maturity models, Quick-checks, types of cooperation, target regions, financial instruments, providing experts on technical subjects, etc.)
- Open discussions on business models, indicating business opportunities for small and medium-sized suppliers
- Creating suitable interfaces for cross-company eTools
- Support for cooperations by including them in industry procurement policy
- Simplifying and standardizing contractual relationships, especially in the downstream value chain (Tier 2 and below)
- Financial assistance for multidisciplinary activities (e.g. sponsoring events, SCE program office activities)

Action required on the part of associations
- Nationwide transparency and cooperation, coordinated action in all regions (one contact person)
- Cooperation on a work-sharing basis under the roof of the SCE Initiative, mutual assistance and communication with SMES, regional involvement of government and administration in the various regions
- Providing the companies equivalent access nationwide to all activities
- Providing resources for joint activities of the SCE Initiative
- Active promotion of SCE activities in the individual areas of involvement
### Action required of the Federal Government

- Strengthening industry policy supportive of SMEs both nationally and internationally
- Introducing a funding network for industry cooperations in the aerospace industry
- Continuation of financial support for aircraft suppliers to global customers
- Expansion of business contact circles in cooperation with the SCE Initiative together with the aerospace industry to anchor German suppliers more firmly in international programs

### Action required of the Länder

- Specific assistance for development projects within the companies (e.g. SME Vouchers, low-threshold innovation assistance – including process and organization innovation, certification assistance, etc.)
- Strengthening the regional aerospace clusters as direct local contacts for SMEs
- Better use and development of available funding programs in line with industrial requirements
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Supply Chain Excellence in the German Aerospace Industry

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Glossary

Abbildung 1
Figure 1: Work groups of the Supply Chain Excellence Initiative

<table>
<thead>
<tr>
<th>Geschäftsmodelle</th>
<th>Business Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internationalisierung</td>
<td>Internationalization</td>
</tr>
<tr>
<td>Industrial Performance</td>
<td>Industrial Performance</td>
</tr>
<tr>
<td>Finanzierung &amp; Verträge</td>
<td>Financing &amp; Contracts</td>
</tr>
<tr>
<td>Kooperationen</td>
<td>Cooperations</td>
</tr>
</tbody>
</table>

Abbildung 2
Figure 2: Implementation Consortium for the SCE Initiative

<table>
<thead>
<tr>
<th>Schirmherrschaft aus der Politik</th>
<th>Government sponsors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unterstützung durch Regionalverbände, Landesinitiativen, BDLI und SPACE Deutschland</td>
<td>Support from regional associations, Länder initiatives, BDLI and SPACE Deutschland</td>
</tr>
<tr>
<td>BMWi</td>
<td>Federal Ministry for Economic Affairs and Energy</td>
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<tr>
<td>Bayerisches Staatsministerium für Wirtschaft und Medien, Energie und Technologie</td>
<td>Bavarian Ministry for Economic Affairs and Media</td>
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<tr>
<td>Niedersächsisches Ministerium für Wirtschaft, Arbeit und Verkehr</td>
<td>Lower Saxony Ministry for Economic Affairs, Labor and Transportation</td>
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<tr>
<td>Hamburg Behörde für Wirtschaft, Verkehr und Innovation</td>
<td>Department of Economics, Transport and Innovation</td>
</tr>
<tr>
<td>Ministerium für Finanzen und Wirtschaft Baden-Württemberg</td>
<td>Ministry for Finance and Economic Affairs in Baden-Württemberg</td>
</tr>
</tbody>
</table>

Abbildung 3
Figure 3: Industry segments and value-added steps included in the survey (also see Figure 4)

<table>
<thead>
<tr>
<th>Branchenkern: Flugzeugbau</th>
<th>Industry core activity: Aircraft construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Struktur</td>
<td>Structural Component Construction</td>
</tr>
<tr>
<td>Triebwerke</td>
<td>Engines</td>
</tr>
<tr>
<td>Kabine</td>
<td>Cabins</td>
</tr>
<tr>
<td>Systeme</td>
<td>Systems</td>
</tr>
<tr>
<td>Engineering, Testing, Forschung</td>
<td>Engineering, Testing, Research</td>
</tr>
<tr>
<td>Produktionsunterstützung</td>
<td>Manufacturing support</td>
</tr>
<tr>
<td>Anlagenbau</td>
<td>Plant Engineering</td>
</tr>
<tr>
<td>Aftermarket</td>
<td>Aftermarket</td>
</tr>
<tr>
<td>MRO</td>
<td>MRO</td>
</tr>
<tr>
<td>Individuelles Anforderungsprofil der Tier-Stufen je Commodity</td>
<td>Individual tasks at the Tier level per commodity</td>
</tr>
</tbody>
</table>
Abbildung 4  
Figure 4: Illustration of the Tier structure using the example of Structural Component Construction

Illustration of the Tier structure using the example of Structural Component Construction

<table>
<thead>
<tr>
<th>Kategorisierung der Unternehmen nach idealtypische Anforderungen</th>
<th>Categories of companies according to typical tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEM</td>
<td>OEM</td>
</tr>
<tr>
<td>Entwicklung und Integration System Flugzeug</td>
<td>Development and integration of aircraft systems</td>
</tr>
<tr>
<td>Typenzulassung</td>
<td>Aircraft approval standard</td>
</tr>
<tr>
<td>Tier-1</td>
<td>Tier 1</td>
</tr>
<tr>
<td>Entwicklung und Fertigung technisch komplexer Systeme (QSF-C)</td>
<td>Development and manufactur of technically complex systems (QSF-C)</td>
</tr>
<tr>
<td>Luftfahrrechtlicher Verantwortung für Komplettsystem</td>
<td>Aviation regulatory responsibility for entire systems</td>
</tr>
<tr>
<td>Lieferung an OEM</td>
<td>Supplier to an OEM</td>
</tr>
<tr>
<td>QSF-B und C</td>
<td>QSF-B and C</td>
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<tr>
<td>EASA 21J und G</td>
<td>EASA 21J and G</td>
</tr>
<tr>
<td>ISO 9100</td>
<td>ISO 9100</td>
</tr>
<tr>
<td>Tier-2</td>
<td>Tier 2</td>
</tr>
<tr>
<td>Fertigung von Baugruppen / Komponenten (QSF-B) inkl. Prozesskette</td>
<td>Manufacture of component groups / components (QSF-B) including processing chain</td>
</tr>
<tr>
<td>Luftfahrtrechtliche Verantwortung für Produktionsprozess</td>
<td>Aviation regulatory responsibility for the manufacturing process</td>
</tr>
<tr>
<td>Lieferung an Tier-1</td>
<td>Tier 1 supplier</td>
</tr>
<tr>
<td>QSF-B</td>
<td>QSF-B</td>
</tr>
<tr>
<td>EASA 21J oder G</td>
<td>EASA 21J or G</td>
</tr>
<tr>
<td>ISO 9100</td>
<td>ISO 9100</td>
</tr>
<tr>
<td>Tier-3</td>
<td>Tier 3</td>
</tr>
<tr>
<td>Reine Fertigung von Teilen (QSF-A)</td>
<td>Parts manufacture only (QSF-A)</td>
</tr>
<tr>
<td>Wenig bis keine luftfahrtrechtliche Verantwortung (verlängerte Werkbank)</td>
<td>Little or no aviation regulatory responsibility (extended workbench)</td>
</tr>
<tr>
<td>Lieferung an Tier-2</td>
<td>Tier 2 supplier</td>
</tr>
<tr>
<td>QSF-A</td>
<td>QSF-A</td>
</tr>
<tr>
<td>ISO 9001/9100</td>
<td>ISO 9001/9100</td>
</tr>
<tr>
<td>Multi-Tier</td>
<td>Multi-Tier</td>
</tr>
<tr>
<td>Materialien, Normteile</td>
<td>Materials, norm parts</td>
</tr>
<tr>
<td>Betriebsmittel</td>
<td>Equipment</td>
</tr>
<tr>
<td>Personaldienstleister</td>
<td>Personnel service providers</td>
</tr>
</tbody>
</table>
Abbildung 5
Figure 5: Regional distribution of aerospace supply companies in Germany (based on a pre-survey conducted by the SCE Initiative)

Anzahl der Luftfahrbetriebe= Number of aerospace companies

Abbildung 6
Figure 6: Number of operations interviewed in each Land (Federal State)

Abweichungen vom Deutschen:
Mecklenburg-Western Pomerania
Rhineland-Palatinate
Saxony-Anhalt
Lower Saxony
Bavaria
Saxony
Thuringia

Abbildung 7
Figure 7: Geographic distribution of responses

<table>
<thead>
<tr>
<th>Anzahl Rückläufer</th>
<th>Number of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keine Rückläufe</td>
<td>No responses</td>
</tr>
</tbody>
</table>

Abbildung 8
Figure 8: Number of companies according to revenue

<table>
<thead>
<tr>
<th>Mio</th>
<th>million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umsatz pro Betrieb</td>
<td>Revenue per company</td>
</tr>
<tr>
<td>Zahl der Betriebe</td>
<td>Number of companies</td>
</tr>
</tbody>
</table>

Abbildung 9
Figure 9: Number of companies according to number of employees

<table>
<thead>
<tr>
<th>Insgesamt</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nur Luftfahrt</td>
<td>Aerospace only</td>
</tr>
</tbody>
</table>

Abbildung 10
Figure 10: Projected revenue trends in the next few years

<table>
<thead>
<tr>
<th>Zahl der Antworten</th>
<th>Number of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stark sinkend</td>
<td>Sharp decline</td>
</tr>
<tr>
<td>Leicht sinkend</td>
<td>Slight decline</td>
</tr>
<tr>
<td>Gleichbleibend</td>
<td>Stable</td>
</tr>
<tr>
<td>Leicht steigend</td>
<td>Slight increase</td>
</tr>
<tr>
<td>Stark steigend</td>
<td>Strong increase</td>
</tr>
</tbody>
</table>
Abbildung 11
Figure 11: Manufacturing capabilities

| Additive Produktionsverfahren | Additive manufacturing |
| Montage | Assembly |
| Wärmebehandeln | Heat treating |
| Oberflächenbehandeln | Surface treating |
| Kleben | Bonding |
| Schweißen | Welding |
| Nieten | Riveting |
| Blechbearbeitung | Sheet metal work |
| Fräsen | Milling |
| Drehen | Lathing |
| Umformen | Recasting |
| Urformen | Casting |
| Engineering | Engineering |

Abbildung 12
Figure 12: Materials competencies

| Kunststoffe | Plastics |
| Aluminiumwerkstoffe | Aluminum materials |
| Verbundwerkstoffe | Composites |
| Hartmetallwerkstoffe | Hard metals |

Abbildung 13:
Figure 13: Service competencies

| Wartung | Maintenance |
| Testing | Testing |
| Simulation | Simulation |
| Personal | Personnel |
| Logistik | Logistics |
| Montage | Assembly |

Abbildung 14
Figure 14: Certifications

| Aktuell | Current |
| Angestrebte | Planned |

Abbildung 15
Figure 15: Ideal structure for the aerospace value chain
Abbildung 16
Figure 16: The German supplier industry categorized by value-added steps

<table>
<thead>
<tr>
<th>OEM</th>
<th>OEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systemlieferant</td>
<td>Systems supplier</td>
</tr>
<tr>
<td>Komponentenlieferer</td>
<td>Components supplier (Tier 2)</td>
</tr>
<tr>
<td>Teilelieferant (Tier 3)</td>
<td>Parts supplier (Tier 3)</td>
</tr>
<tr>
<td>Multi-Tier</td>
<td>Multi-Tier</td>
</tr>
<tr>
<td>Keines/N.A.</td>
<td>Other /n.a.</td>
</tr>
<tr>
<td>Anlagenbau/Jigs &amp; Tools</td>
<td>Plant engineering /Jigs &amp; Tools</td>
</tr>
<tr>
<td>Wartung/MRO</td>
<td>MRO</td>
</tr>
<tr>
<td>Engineering/Testing/Qualifikation/</td>
<td>Engineering/Testing/Qualifikation/</td>
</tr>
<tr>
<td>Dokumentation/Forschung</td>
<td>Documentation/Research</td>
</tr>
<tr>
<td>Systeme</td>
<td>Systems</td>
</tr>
<tr>
<td>Kabine</td>
<td>Cabins</td>
</tr>
<tr>
<td>Triebwerke</td>
<td>Engines</td>
</tr>
<tr>
<td>Struktturbau</td>
<td>Structural Components</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
</tr>
</tbody>
</table>

Abbildung 17
Figure 17: Supply companies categorized by industry segment
(bitte Abbildung 16 entnehmen)

Abbildung 18
Figure 18: Regional distribution of MRO companies
(bitte Abb. 16 entnehmen, ansonsten: Wartung/MRO= MRO, Keine Betriebe= no companies, und N/A= n.a.)

Abbildung 19
Figure 19: Regional distribution of suppliers by segment
(bitte Abb. 16 entnehmen, ansonsten: Keine Betriebe= no companies, und N/A= n.a.)

Abbildung 20
Figure 20: Company self-assessments of their position in the supply chain in 2016 and 2021
Anteil der Befragten=Percentage of companies responding

Abbildung 21
Figure 21: Company self-assessments of change in their position in the supply chain between 2016-2021
(Bitte Abb. 16 entnehmen)
Abbildung 22  
*Figure 22: Participation of German aerospace suppliers in aircraft programs*

Zahl der Betriebe: Number of companies

Abbildung 23  
*Figure 23: Top customers of German aerospace suppliers (by revenue)*

Zahl der Betriebe: Number of companies

Abbildung 24  
*Figure 24: Networks of the German aerospace supplier industry with other industries*

| Automotive | Automotive |
| Maschinen-/Anlagenbau (Text nicht ganz vorhanden) | Plant Engineering and Jigs & Tools |
| Optische Technologien | Optical technology |
| Industrielektronik | Industrial electronics |
| Pharma / Medizintechnik | Pharma / Medical engineering |
| Energieerzeugung | Energy production |
| Halbzeuge für Nicht-LRI-Anwendungen | Semi-finished products for non-aerospace applications |
| IT/Telekommunikation | IT/Telecommunications |
| Mess-, Steuer- und Regelungstechnik | Measurement and control technology |
| Sonstiges | Other |

Abbildung 25  
*Figure 25: International sites and sales networks of the German aerospace industry*

Standorte im Ausland= Sites outside of Germany
Unter 3= less than 3
Abbildung 26
Figure 26: Top target markets of the German aerospace industry

<table>
<thead>
<tr>
<th>Deutschland</th>
<th>Deutschland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Österreich</td>
<td>Austria</td>
</tr>
<tr>
<td>Schweiz</td>
<td>Switzerland</td>
</tr>
<tr>
<td>Frankreich</td>
<td>France</td>
</tr>
<tr>
<td>Italien</td>
<td>Italy</td>
</tr>
<tr>
<td>UK</td>
<td>UK</td>
</tr>
<tr>
<td>Sonstige EU</td>
<td>Other EU countries</td>
</tr>
<tr>
<td>Europa nicht EU</td>
<td>Non-EU countries in Europe</td>
</tr>
<tr>
<td>Russland</td>
<td>Russia</td>
</tr>
<tr>
<td>Asien</td>
<td>Asia</td>
</tr>
<tr>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>Kanada</td>
<td>Canada</td>
</tr>
<tr>
<td>Südamerika</td>
<td>South America</td>
</tr>
<tr>
<td>Sonstiges</td>
<td>Other</td>
</tr>
<tr>
<td>Absatz</td>
<td>Sales</td>
</tr>
<tr>
<td>Produktion</td>
<td>Production</td>
</tr>
<tr>
<td>Beschaffung</td>
<td>Procurement</td>
</tr>
</tbody>
</table>

Abbildung 27
Figure 27: Assessment of sales and competition potential for German suppliers in international target markets

(bitte Abb. 26 entnehmen, ansonsten: Zahl der Nennungen= Number of responses, Absatzpotenzial= Sales potential, Konkurrenzpotential= Potential competition)

Abbildung 28
Figure 28: The competitive position of German suppliers compared with their largest competitors

<table>
<thead>
<tr>
<th>Fähigkeiten zur .....</th>
<th>Ability to take on program risks (pre-financing product development and integration of a supply chain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovationskraft...</td>
<td>Innovative strength (technology, financing)</td>
</tr>
<tr>
<td>Hoch</td>
<td>Strong</td>
</tr>
<tr>
<td>Gering</td>
<td>Weak</td>
</tr>
</tbody>
</table>
Abbildung 29
Figure 29: Top challenges for aerospace suppliers in Germany

<table>
<thead>
<tr>
<th>Zahl der Nennungen</th>
<th>Number of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuausrichtung des Geschäftsmodells</td>
<td>Re-alignment of the company business model</td>
</tr>
<tr>
<td>Internationalisierung</td>
<td>Internationalization</td>
</tr>
<tr>
<td>Industrial Performance</td>
<td>Industrial Performance</td>
</tr>
<tr>
<td>Schnittstellen zwischen Unternehmen</td>
<td>Interfaces between companies</td>
</tr>
<tr>
<td>Kooperationen</td>
<td>Cooperations</td>
</tr>
<tr>
<td>Finanzierung &amp; Verträge</td>
<td>Financing &amp; Contracts</td>
</tr>
<tr>
<td>Sonstiges</td>
<td>Other</td>
</tr>
</tbody>
</table>

Abbildung 30
Figure 30: Division of work within the Supply Chain Excellence Initiative

<table>
<thead>
<tr>
<th>Leitung</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support</td>
<td>Support</td>
</tr>
<tr>
<td>Assoziierte Partner</td>
<td>Associated members</td>
</tr>
<tr>
<td>Geschäftsmodelle</td>
<td>Business models</td>
</tr>
<tr>
<td>Kooperationen</td>
<td>Cooperations</td>
</tr>
<tr>
<td>Finanzierung &amp; Verträge</td>
<td>Financing &amp; Contracts</td>
</tr>
<tr>
<td>Industrial Performance</td>
<td>Industrial Performance</td>
</tr>
<tr>
<td>Internationalisierung</td>
<td>Internationalization</td>
</tr>
</tbody>
</table>

Abbildung 31
Figure 31: Overview of the action plan for the Supply Chain Excellence Initiative

<table>
<thead>
<tr>
<th>Übergreifende SCE-Aktivitäten</th>
<th>Primary SCE activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strukturmonitoring</td>
<td>Structural Monitoring</td>
</tr>
<tr>
<td>Projektmanagement</td>
<td>Project Management</td>
</tr>
<tr>
<td>Marketing und Außenauftritt</td>
<td>Marketing and Image</td>
</tr>
<tr>
<td>Geschäftsmodelle</td>
<td>Business Models</td>
</tr>
<tr>
<td>Rollemodelle/Geschäftsmodelltypen</td>
<td>Role models / business model types</td>
</tr>
<tr>
<td>Entwicklung Quick-Check/Konsolidierung Reifegradmodelle</td>
<td>Creating a Quick-check / Consolidating industry maturity models</td>
</tr>
<tr>
<td>Roll-Out Quick Check</td>
<td>Roll-out of Quick-checks</td>
</tr>
<tr>
<td>Internationalisierung</td>
<td>Internationalization</td>
</tr>
<tr>
<td>Identifikation, relevanter Zielregionen</td>
<td>Identifying relevant target regions</td>
</tr>
<tr>
<td>Bestandsaufnahme und Analyse Zielregionen</td>
<td>Status quo and analysis of target regions</td>
</tr>
<tr>
<td>Aufzeigen Handlungsoptionen</td>
<td>Identifying options for market entry</td>
</tr>
<tr>
<td>Geschäftsanbahnungsreisen</td>
<td>Business acquisition travel</td>
</tr>
<tr>
<td>Industrial Performance</td>
<td>Industrial Performance</td>
</tr>
<tr>
<td>SPACE Diagnosen und Verbesserungsprojekte</td>
<td>SPACE Diagnostics and improvement projects</td>
</tr>
<tr>
<td>Performance Reifegradmodell</td>
<td>Industrial maturity models for performance</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Trainings- und Netzwerkveranstaltungen zu neuen Technologien</td>
<td>Training and networking events on new technologies</td>
</tr>
<tr>
<td>Zertifizierungsworkshops</td>
<td>Certification workshops</td>
</tr>
<tr>
<td>Finanzierung &amp; Verträge</td>
<td>Financing &amp; Contracts</td>
</tr>
<tr>
<td>Aufbau Expertenpools</td>
<td>Creating expert pools</td>
</tr>
<tr>
<td>Info-Veranstaltungen</td>
<td>Informational events</td>
</tr>
<tr>
<td>Zusammenbringen von Unternehmern und Experten</td>
<td>Bringing companies and experts together</td>
</tr>
<tr>
<td>Führungskräftequalifizierung</td>
<td>Manager training</td>
</tr>
<tr>
<td>Training SCM-Spezialisten</td>
<td>Training SCM specialists</td>
</tr>
<tr>
<td>eTools</td>
<td>eTools</td>
</tr>
<tr>
<td>Kooperationen</td>
<td>Cooperations</td>
</tr>
<tr>
<td>Kooperationsworkshops</td>
<td>Cooperation workshops</td>
</tr>
<tr>
<td>Kooperations-Modelle /-koordinatensystem</td>
<td>Cooperation models and coordinate systems</td>
</tr>
<tr>
<td>Kooperationssimulation</td>
<td>Simulating cooperations</td>
</tr>
<tr>
<td>Kooperations-Partnersuche</td>
<td>Finding cooperation partners</td>
</tr>
</tbody>
</table>