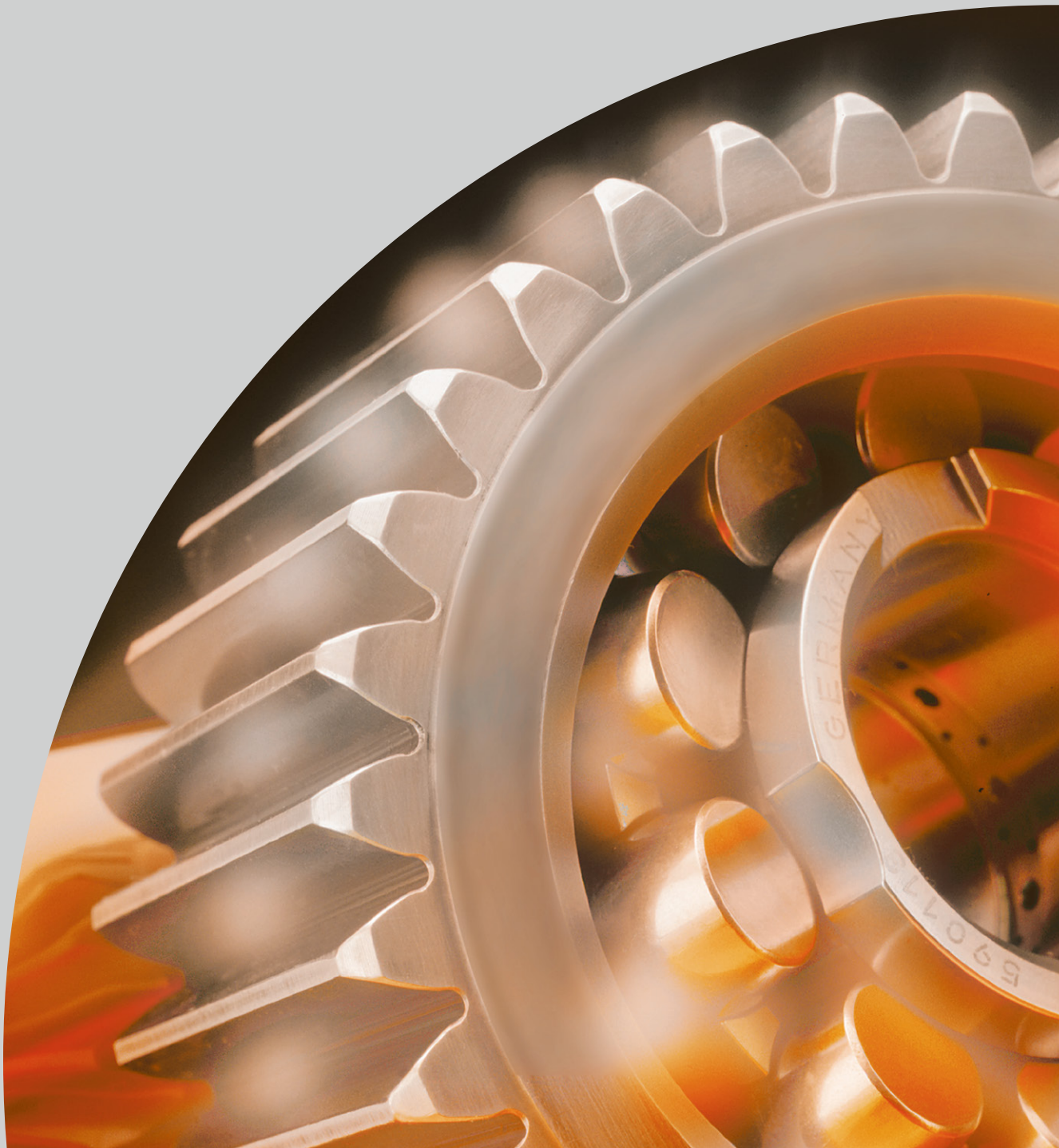
Power Transmission Engineering

VDMA

Business Report
2017 – 2021



Editorial

Wilhelm Rehm

Hartmut Rauen

Dear members,

the last four years have truly been tough. 2019 saw record employment and then an "annus horribilis" 2020 with a global pandemic that no one could escape. Global supply chains were subject to an endurance test. Our society, our political and economic system, and every individual went through weeks and months that were still beyond anyone's imagination at the beginning of our reporting period.

The cohesion was a help. Empathy, energy and creativity in everyday life, in the companies, in our society were also intensive positive experiences. As VDMA, we tried to make our contribution with all our strength. With tailor-made solutions, advice and many new web offerings. A new peak in the number of members is confirmation of that.

According to Winston Churchill, politicians think about the next election, statesmen – and stateswomen! – think about the next generation. Many debates in recent years show that in Germany, politicians often have the upper hand. Technological performance, excellence in education, engineering and research, and the competitiveness of our industry must be the maxim of every new federal government from this autumn onward.

The world has changed. Its western part has been fragile in these four years. Trumpism, Brexit and national egoisms even in our European home weakened us from inside. Nevertheless: our industry is a global one. The VDMA has expanded its international activities, most recently with an office in the USA. Europe is our base, that's why we invite European machine builders to join us.

Common goals and international effectiveness will determine the success of the industrial transformation. The best example is our path toward intelligently networked, sustainable production. The Industrial Digital Twin Association, a new VDMA-initiated association, the VDMA working group „Wireless Communications for Machines" and our OPC UA activities – e. g. for the servo drive system – mark the path to the „Big Picture Industrie 4.0".

The movement away from fossil fuels is also a major challenge. Many companies are looking for transparency, orientation and help in the transition. At the VDMA, we see it as a high priority – with the VDMA study series „Drivetrain in Transition," our world-leading Research Association FVA, and the #XMOTIVE forum, which combines a comprehensive range of services for VDMA members.

We want to be the driver and not the driven one. The Management Board has identified two key areas for our strategic positioning in 2021: With „Drive4Green“, we want to focus more strongly on climate-neutral, sustainable production. „Drive Technology 4.0“ is an exemplary roadmap process that shows the best development steps toward intelligently networked, sustainable production.

Drive technology is at the heart of the transformation. We turn ideas into reality, and the virtual becomes the reality of motion via force and torque. Our products are an important source of data.

The global showcase for our innovative strength and the transformation process is the HANNOVER MESSE in Germany – here as well as at many leading trade fairs and congresses, we are active as an association and visible as a community.

Thank you for your commitment to the VDMA, for being part of this strong community that has proven itself even in difficult times! The prospects for our industry are good and we are tackling the challenges.

Therefore, we look forward to continued successful cooperation with you and are confident about the future – may the coming period bring many „anni mirabiles“!

Wilhelm Rehm
Chairman
Power Transmission
Engineering Association

Hartmut Rauen
Managing Director
Power Transmission
Engineering Association

VDMA Power Transmission Engineering

The Power Transmission Engineering association represents the interests of around 200 member companies that produce drive elements, gears, linear technology and electrical drive technology, among other things. Drive technology is one of the largest sub-sectors of mechanical and plant engineering.

The main tasks are identified by the board of directors, which is made up of representatives from the industry and determines the strategic direction for the four-year election period. The association connects its members locally and worldwide.

Focal Points of the Association's Work

- Market information/statistics: especially for drive technology and mostly exclusively for members
- Technology and standardisation: informing about trends at an early stage and helping to shape standards
- Research: providing access to research results
- Networking with customer industries, e. g. mechanical engineering in the VDMA
- Trade fairs and public relations work: make the industry known worldwide and facilitate market access
- Promoting European and international networking and thus supporting each other
- Networking with start-ups

The Economic Significance of the Branch

Worldwide, drive technology has an estimated production volume of over 200 billion euros. In the statistical surveys of the VDMA, mainly mechanical drive technology is represented with a production volume of approximately 15 billion euros. In addition, electrical drive technology must be taken into account with a further approx. 10 billion euros. For years, drive technology has had an export quota of over 80 percent, the most important sales markets are China, the USA and Europe. The branch is an employer for about 92,000 employees (2020).

Review

The years 2017 and 2018 were characterised by great dynamism. German manufacturers of drive technology celebrated an all-time high in 2018 with a production volume of almost 18 billion euros, although many companies have noticeable production capacities in export markets.

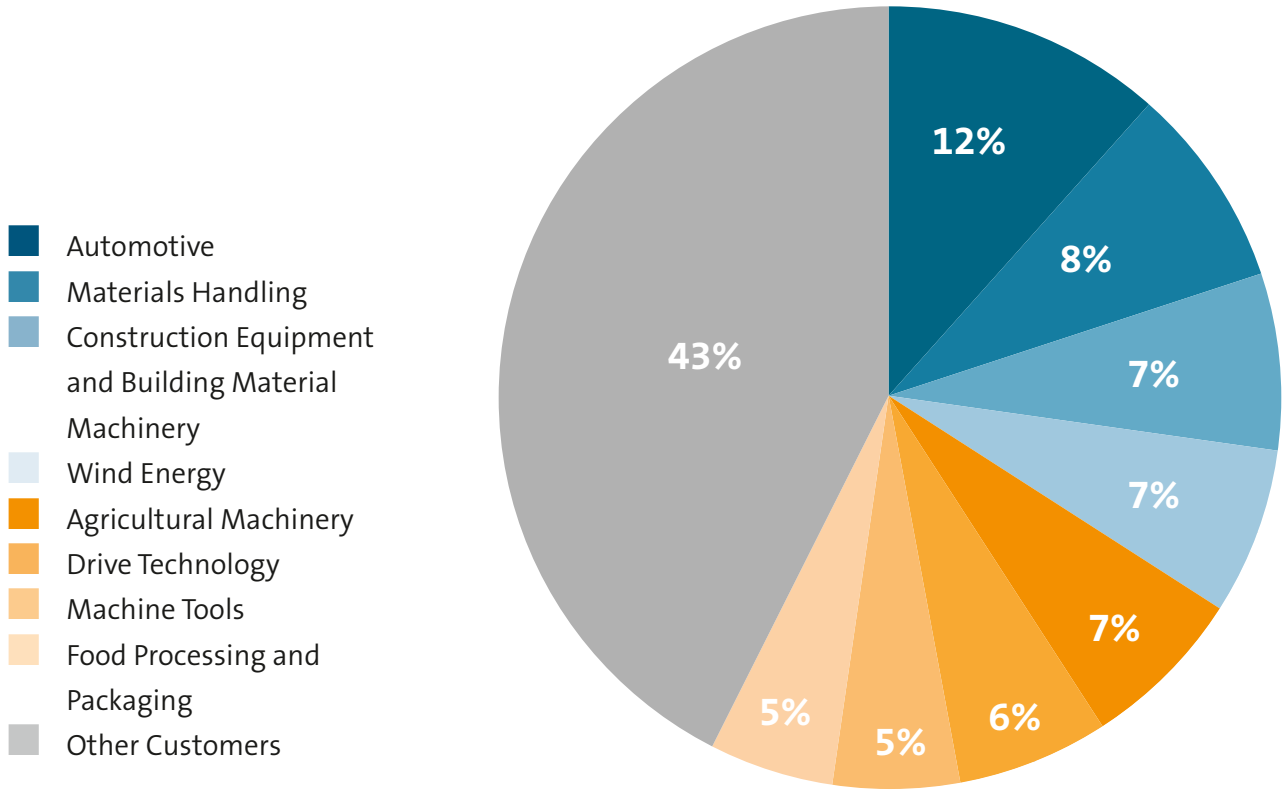
Due to the trend towards alternative drive technologies, an initial slowdown was noticeable at the beginning of 2019, which was massively accelerated by the pandemic. In 2020, the branch noted a decline of 11 per cent in production and 13 per cent in turnover compared to 2019.

Prospect 2021

The drive technology branch recorded a price-adjusted increase of 38 percent in new orders from January to June 2021. The base effect of the previous year certainly contributed to the positive

Main Customer Markets Drive Technology

in % of the domestic sales 2020



Source: VDMA

figures, but more decisive is the fact that projects got off to a fast start after the pandemic year 2020 and most companies got through the pandemic without a hard lockdown. Overall, demand from the important customer industries is positive and foreign business is also doing well. The challenge for the future will be to stabilise the global supply chains for future market developments, to optimally exploit digitalization and to proactively implement the topic of sustainability/climate neutrality.

Compared to 2020, an increase in turnover corresponding to the 10 percent forecast by the mechanical engineering industry seems conceivable for drive technology. The reasons for this are the broad positioning of the branch and the fact that it offers solutions for many challenges of the future – digitalization, sustainability and mobility. The Chinese market in particular guarantees robust demand even during the pandemic. The large economic stimulus package in the USA will also have a positive impact on the sales opportunities for drive technology.

Network and Collaboration

The board of the association is composed of senior representatives of the industry elected by the general meeting. At the general meeting in September 2021, the board will be elected for the next four-year term. It determines the strategic orientation of the association.

The economic and technical **expert networks** of the Power Transmission Engineering association also offer many opportunities for networking and collaboration:

- Economic committee – central body for industry-relevant questions and topics
- Working groups:
  Plain Bearings, Linear Technology, Electrical Power Transmission Engineering, Industrie 4.0/OPC UA Drive Technology and Trade Fairs/ Marketing
- Standards committees:
  Strength and Quality of Gear Materials, Plastic Gears, Wind Turbine Gearboxes and many more

The VDMA Competence Centre **Future Business** opens future topics in mechanical engineering, including for drive technology. Trend radar and scenario studies help VDMA members to identify trends and disruptions for the industry at an early stage and to make them usable. Best practices and new methods for future research and innovation management are exchanged in the Corporate Foresight expert group.

VDMA **Startup-Machine**, as part of this Competence Centre, introduces members to promising start-ups and thus helps to bring new trends quickly into application.

The Power Transmission Engineering association benefits greatly from the close cooperation with the **Research Association for Drive Technology** (Forschungsvereinigung Antriebstechnik e. V. – FVA) and can thus draw on a world-leading innovation ecosystem of industry and science.

At the European level, the sector committee **EUROTRANS** represents the economic and technical interests of drive technology; the general secretariat is held by VDMA.

The European rolling bearing industry is represented by FEBMA, the Federation of European Bearing Manufacturers' Association, whose general secretariat is held by VDMA. FEBMA is a founding member of the World Bearing Association (WBA).

Management meetings in China and India support local contacts and are organised by the VDMA representative offices in the corresponding countries.

- Executive Board Power Transmission Engineering
- Expert Networks Power Transmission Engineering
- Future Business & Startup-Machine
- Research Association for Drive Technology – FVA
- EUROTRANS

Key Topics in Drive Technology

An analysis of the most important trends for drive technology was carried out by the association's board during the reporting period. Priority topics were digitalization and sustainability, which were implemented in working groups together with the association board in 2021.

Sustainability and Climate Protection:

Drive4Green

Efforts in the areas of sustainability and climate-neutral production are growing rapidly in the industrial environment. Drive technology companies are also confronted with the need to develop new solutions in this environment. In addition, there are legal manufacturer obligations in the area of recycling management, material compliance and additional challenges due to digitalization.

The "Drive4Green" event in June 2021 marked the start of the drive technology-related consideration and processing of the challenges in the field of environment and sustainability. Together with the member companies and the VDMA Technology, Environment and Sustainability Department, the association will develop and implement needs-based measures (events, committees, assistance).

Digitalization:

Guideline Drive Technology 4.0: Digitalization Trends for Product, Production and Supply Chain

The methods and approaches of Industrie 4.0 are already being used by many companies. The dynamics and potential to increase competitiveness associated with the digital transformation permanently present companies with high strategic challenges.

For the targeted implementation of digitalization and Industrie 4.0, the board of the association has initiated a sector-specific implementation guideline for drive technology 4.0, which was implemented in cooperation with the wbk Institute of Production Science at KIT, Karlsruhe/Germany.

The guideline is based on expert interviews with supplier companies and customers in the drive technology sector as well as a survey of association members and includes practical examples. The guidelines will be published at the 2021 general meeting of the Power Transmission Engineering association.

OPC UA in Drive Technology

Since 2018 the joint working group "Industrie 4.0/ OPC UA drive technology" between VDMA Power Transmission Engineering association and the OPC Foundation has been working on an OPC UA Companion Specification for the electric powertrain including transmission elements with a focus on Industrie 4.0 applications.

In the first part of the specification, a manufacturer-independent information model of the powertrain is provided, which enables the user to implement consistent asset management applications.

The interface standard claims to cover all types of electrical powertrain including mechanical transmission elements. It can be used for a powertrain consisting of a motor starter, motor and gearbox as well as for complex motion or multi-axis systems.

WBACheck-App – Stop fake bearings!
The World Bearing Association (WBA) has developed an app to support the fight against fake bearings. The **WBACheck** app is an authentication system that allows users to verify the authenticity of each bearing in seconds through a machine-readable, globally unique QR/DMC code.

The WBACheck is recommended by leading international manufacturers – Schaeffler, SKF, Timken, NTN, NSK, NACHI and JTEKT. The WBA Authenticator App (WBACheck) is available for free download from the app stores.

WBACheck-App – Stop fake bearings

Big Picture Industrie 4.0

The core of Industrie 4.0 is the beneficial networking of technical production goods and the interoperability between components, machines and systems.

Several VDMA initiatives, mosaic building blocks, are forming the picture of an interoperable system landscape of intelligently networked production Industrie 4.0. In many cases, drive technology companies are leading players in this.

The initiatives focus on:

- Connectivity – **how** data is transmitted
- Standardised interface – **which** information is transmitted
- Digital twin – **consolidation** of information

Connectivity: Wireless Transmission Technologies

Industrial-grade wireless connectivity makes it possible to exploit the potential of existing and new applications by relying on efficient, secure and flexible data transmission in machinery and plant engineering.

The VDMA working group Wireless Communications for Machines supports machine manufacturers in the integration of wireless systems in product and production and offers all know-how carriers an application-oriented network. In addition, we are the conceptual sponsor of the trade fair CMM – Connected mobile Machines & Mobility, which is held annually in Hanover/Germany.

Standardised Interface: OPC UA

The OPC UA interface standard is suitable for specifying data and information according to a consistent scheme. The aim is to define which information is transmitted, thus creating a world language of production and ensuring that the production systems involved also understand each other on a semantic level.

Our OPC UA activities and the dissemination through the “umati” brand and community have been a strategic pillar for the VDMA for years.

Digital Twin: IDTA

The industrial digital twin aims at continuous data availability along the life cycle of a component, machine or plant – from product planning through development, production, commissioning and use to recycling. This creates the conditions for new value creation networks across company boundaries.

The Industrial Digital Twin Association e. V. (IDTA) is the central point of contact for the digital twin – an alliance of active designers co-initiated by the VDMA, who make the digital twin practically usable for industry through open technologies.

Drivetrain in Transition

The transformation towards CO_2-free mobility is in full swing – not only in the automobile, but also in mobile machinery and ships. The VDMA supports its members in assessing the impact of the „drivetrain in transition“.

Studies „Drivetrain in Transition“

Together with FEV Consulting GmbH, three studies were published exclusively for VDMA members in the period 2018 to 2021. The impact of electrification and fuel cell technology on value creation in the powertrain was analysed. Emissions legislation in particular shows that only locally CO_2-free powertrains can probably be sold in Europe in 2040. In addition to battery electric vehicles, the importance of fuel cell vehicles will increase significantly with a market share of about 22 percent. The studies have met with a great response from the membership, but also from politicians and the public.

Mobility of the Future

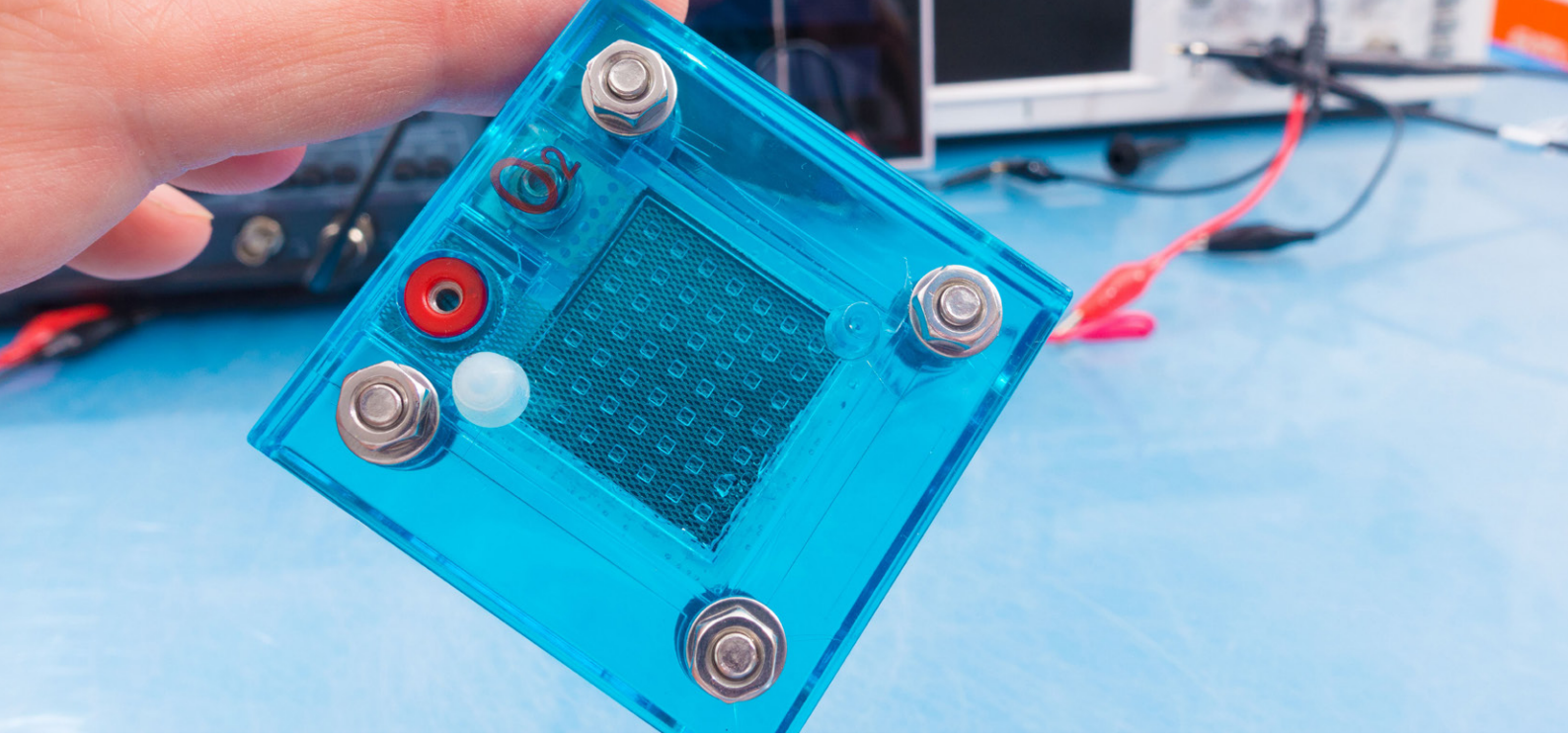
Forum #XMOTIVE

The VDMA is broadly and powerfully positioned regarding the mobility of the future. The entire spectrum of mobility is represented in the VDMA. This means that companies in the drive technology sector can orient themselves excellently and contribute in a targeted manner along the entire value chain, from research and production to application. The diverse competences are bundled in the #XMOTIVE forum to prepare the member companies for the future of mobility and to support them in the change.

The #XMOTIVE forum was launched in 2020 as a network platform under the motto „Produce Future Mobility“. Members are offered a broad portfolio of services. In addition to the connection to politics and exchange within the VDMA on the future of mobility and its production, members receive the latest research knowledge and information about the industry via studies and events.

Studies Drivetrain in Transition

Mobility in the VDMA



E-MOTIVE Expert Forum

The E-MOTIVE Expert Forum has been the central networking platform for experts from industry and science for electrified vehicle powertrains for many years.

The expert forum addresses the changes in the powertrain towards more and more electric and electronic components and offers international experts from implementing companies as well as institutes the opportunity to inform themselves about the latest research results and developments in industrial practice and to exchange ideas. After successful events with around 250 participants each in 2018 in Stuttgart/Germany and 2019 in Schweinfurt/Germany, the expert forum was held online in 2020 with more than 800 participants.

In 2022, the **14th Expert Forum** will be held in Wolfsburg/Germany from 21th to 22th September.

Fuel Cell Drives

Fuel cell drives combine the advantages of battery electric drives (zero emissions, low noise) with those of internal combustion engine drives (high energy density of the fuel, recovery of braking energy).

The VDMA has been working on fuel cells in its own working group since 2003. The focus was on the further technical development of fuel cells. Important development goals have been achieved in the areas of performance and lifetime. The challenges now lie in cost reduction, which requires above all the industrialisation of production processes. This is the focus of VDMA activities. Well-known OEMs are in the process of investing in large-scale production.

Online Event E-MOTIVE 2021 by FVA

Publication Production of Fuel Cell Systems

Climate Protection

Power-to-X (P2X) for Applications

The further expansion of renewable energies, increased energy efficiency and sector coupling are essential for achieving the climate targets. Mechanical and plant engineering plays an outstanding role and offers P2X, an excellently suited **technology for sector coupling**. Particularly in aviation, shipping, and road freight transport as well as in agricultural engineering and for construction machinery, liquid and gaseous fuels will also be needed in the long term. There, hydrogen can power engines directly or as processed eFuel.

The VDMA **working group "Power-to-X for Applications"** is the central, cross-industry platform for information, communication and cooperation for the P2X community. It connects all important stakeholders and players from the development of manufacturing processes via the production of synthetic fuel and raw materials using Power-to-X technologies to the end user.

P2X – Technologies for Sector Coupling

Working Group Power-to-X for Applications

Standardization in Drive Technology

The Power Transmission Engineering association organizes national standardization in the field of mechanical drive technology and holds the secretariats of various technical committees and working groups at international level. With early involvement in the standardization work, companies can actively influence the content of national and international standards and identify trends at an early stage.

The professional exchange and discourse at the highest level between experts from industry and research in the committees leads to a knowledge advantage over other market participants. Product design and development in companies can use this knowledge to gain a time advantage. In addition, standards improve communication between contracting parties.

As part of the technical representation of interests, the association supports the work of the experts in the standardization committees. In addition, VDMA working groups can develop technical positions of the industry on specific topics and publish them as VDMA-Specifications. These can be served as formulated proposals and can be introduced into national or international standardization.

Drive Technology for Wind Industry

Cast Structural Components in Wind Turbines

This working group developed a guideline for the fracture mechanics verification of planetary carriers made of high strength cast iron material using Linear Elastic Fracture Mechanics (LEBM), which was published as a new edition in 2014. A report from the industry indicated that in some cases this method was also being applied to components outside the scope of the specification, for example on main shafts. Furthermore, topics are continuously being identified which may improve the contents of the guideline. If necessary, these topics could first be addressed in the working groups of the Research Association for Drive Technology (Forschungsvereinigung Antriebstechnik e. V. – FVA).

Plain Bearings in Wind Turbine Gearboxes

This working group develops requirements for plain bearings in main gearboxes considering the state of the art and best practice. As the use of plain bearings in wind turbines is still a new technology, experience must first be gathered for the specific applications. After seven meetings, the VDMA-Specification “Design of plain bearings in main gearboxes of wind turbines”

Standardization in Drive Technology

150 **National Meetings (DIN)**
1050 Participations of Experts 2018 – 2021

132 **International Meetings (ISO/IEC)**
584 Participants of German Delegates 2018 – 2021

developed by the committee was published in January 2019. As part of the revision of IEC standard 61400-4 "Design requirements for wind turbine gearboxes", the contents of the VDMA-Specification were introduced into international standardization and are intended to supplement the sections relating to bearings to expand the experience base.

Reliability of Gearboxes in Wind Turbines

This working group is engaged in the development of a generally applicable calculation method for the system reliability of main gearboxes. As a result of numerous meetings, the VDMA-Specification "Reliability assessment for wind gearboxes" was published. It serves as a template and basis for discussion for a technical specification and was introduced as part of the international standardization work to revise the authoritative standard for gearboxes in wind turbines, IEC 61400-4 "Design requirements for wind turbine gearboxes".

Machinery Directive

Working Group Gearboxes and Geared Motors

The working group is concerned with the interpretation of the machinery directive in relation to gearboxes and geared motors. The revised version of the machinery directive (version 2.0) has led to uncertainties in the interpretation of the classification of products and corresponding discussions in the market environment. This was taken as an opportunity to revise the existing position paper from 2009 and to adapt it to changes in case law. After eleven meetings of the committee, the revised version of the position paper "Classification of gearboxes and geared motors under the EG Machinery Directive 2006/42/EG" was published.

The activities in the context of the upcoming revision of the machinery directive into a machinery ordinance are currently being accompanied and commented on by experts from the body, so that concerns can be formulated and addressed at an early stage.

Research Is Our Driving Force

Joint research in the Research Association for Drive Technology (Forschungsvereinigung Antriebstechnik e. V. – FVA)

The successful collaboration with around 200 members of the automotive industry, mechanical engineering and electrical engineering in the technology field of drive technology together with research institutes has made the FVA the world's leading and largest research and innovation network in drive technology. The fact that pre-competitive research at the FVA functions in a special way is based on the trust that manufacturers and suppliers place in each other. From this, FVA develops knowledge and tools for efficient drive technologies.

FVA
sharing drive innovation

The THEMIS digital communication platform has around a thousand users, projects and documents. Digitalization will continue to play a significant role in the future.

The FVA has adapted its training program in recent years: Web seminars can be accessed at any time via the **FVA YouTube-Channel**, and online live seminars are offered at **fva-service.de** (seminars only available in German). The congresses E-MOTIVE (annual) and BEARING World (biennial) were held in 2020 as online events and thus achieved international attention. In addition, cooperation agreements with the WZL of RWTH Aachen University on the topic of **gear production** offer FVA the opportunity to network knowledge and bundle forces.

FVA YouTube-Channel
FVA Live Seminars
Forum on Gear Production

Source: Research Association for Drive Technology – FVA

Research / facts & figures 2020

64 recently started research projects	16,7 research budget
120 research institutes	480 meetings & web conferencing
223 current projects	28 face-to-face seminars, online conference seminars

FVA Software & Service

FVA-Workbench 6: Simulation Platform for Drives

FVA-Workbench 6 can be used to optimize mechanical and hydraulic systems, increase the accuracy of analyses and make development processes more efficient. New in this software version are load capacity verifications of shafts according to FKM guidelines and the exact dimensioning of bevel gears.

New calculation methods of the FVA-Workbench are developed and validated in the FVA network. The software serves as a knowledge platform that makes the research knowledge generated in the projects efficiently usable.

The FVA Simulation Hub

In addition to the calculation departments, there are also other departments of the company such as project management and sales departments that need access to the gear simulations. The new FVA Simulation Hub makes this possible.

All calculations of a development project converge on one server hub. This gives different departments the possibility to use the same models and calculation methods of the FVA in parallel. The FVA Simulation Hub will be available in autumn 2021.

FVA-Workbench

Events and Exhibitions

The drive technology community thrives on the large number of its events and exhibitions, which serve as a platform for the exchange of knowledge and information and thus help to shape the future together.

Trade Fairs

The VDMA supports its member companies in their distribution activities worldwide. It shapes the global exhibition landscape as the conceptual sponsor of leading exhibitions and organizes joint stands, forums and special shows.

Joint Stands on Trade Fairs in Germany

The joint stands, which the Power Transmission Engineering association organizes together with the Fluid Power association and VDMA Services, offer member companies the exclusive opportunity to present themselves prominently and cost-effectively at German exhibitions with an all-round carefree package, so at the HANNOVER MESSE, AGRITECHNICA Systems & Components and bauma.

61 Onsite Events 2018 – 2021

97 Webmeetings 2018 – 2021

German Pavilions Abroad

The foreign trade fair program is an important component of export promotion by the German Federal Ministry for Economic Affairs and Energy. For the exploitation of foreign markets, the VDMA submitted annual applications for funding for German Pavilions worldwide, the Power Transmission Engineering association especially for trade fairs in China, Turkey and the USA. Until the outbreak of the pandemic, all of them were successfully held, in China even onsite in 2020.

Forums

The association organizes forums on trend topics in drive technology at trade fairs in Germany and abroad. Predictive maintenance, smart manufacturing and intelligent drive technology with OPC UA as part of Industrie 4.0, as well as new drive technologies, have been at the top of the agenda at HANNOVER MESSE in Germany and PTC ASIA in China over the past four years.

At the digital HANNOVER MESSE 2021 (Hanover Fair), the association contributed its expertise together with its member companies and presented studies on future drive technologies and OPC UA.

Special Shows

Highlights at HANNOVER MESSE up to and including 2019 were the special shows “Predictive Maintenance” and “Intelligent Power Transmission Engineering and Fluid Power” initiated by the association. The association also supported the guided tours that accompanied the special shows.

Public Relations

The association’s public relations activities are an essential part of the information exchange process, serving a wide variety of channels. The following publications have been issued:

- Brochure “VDMA Power Transmission Engineering – The leading European network”
- English newsletter “VDMA Highlights”
- Country specific newsletters
- Economic reports of the automotive and supplier industry
- Launch of the new **VDMA platform** with a topic-oriented focus in March 2021

Events and Exhibitions

VDMA-Platform

Further Information

Up-to-date information are always available on the new VDMA and Power Transmission Engineering web platform. Via a personal login, you can subscribe to selected topics and thus continuously stay up to date, tailored to your interests.

- More than **200 member companies** of the Power Transmission Engineering association can be found in our online directory.
- As a member of the association, you can request a wide range of **market information**. No other source provides such comprehensive and up-to-date data for power transmission engineering.
- Find out more about the **DIN and ISO standardization committees** and standards in the Power Transmission Engineering association.
- With the VDMA newsletters we inform you about current trends, news and events from the VDMA and the world of mechanical and plant engineering – you decide which newsletters we send you specifically.

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DIN and ISO Standardization Committees

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Imprint

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Image Sources
Page 18: FVA e. V.
Page 19: FVA GmbH
Page 23: RENK AG
All other pages: Shutterstock

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VDMA Verlag