

Guidelines

Industry Services

Technical services in the lifecycle
of machines and plants

Dimensioning
Modernisation
Repair Service
Audit
Production & Commissioning
Condition Monitoring
Remote Services
Maintenance
Operation & Optimisation
Spare Parts Service
Construction & Engineering
Field Service
Service Contracts
Data Analysis
Planning & Design
Online Support



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Guidelines

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of machines and plants

The productivity and energy efficiency of industrial machines and plants need to increase further in the future. With a view to meeting the associated requirements, an increased emphasis is being placed on automation as an important lever, as this is the area in which the main innovations are to be expected. The continuous further development of products and solutions requires standardised services that can be flexibly modified and are oriented to the entire lifecycle of an application.

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1. Introduction

Across the entire lifecycle of machines and plants, there is a high demand for industrial services, which bring many advantages for users. The present guidelines from the Service Marketing working group of the Automation Division at ZVEI provide a comprehensive overview of the extensive range of industrial services available on the market.

The rapid technological developments in office and consumer information technology in recent years have reached a degree of sophistication that makes it possible for modified applications to be increasingly used and further developed in the industrial environment. Examples here include, for instance, an integrated communications technology as the interface between service staff and the machine or plant. In the application itself, the lifecycles of components will change. This is not least due to the rising proportion of software in the plants which requires regular updates in order to improve performance and ensure serviceability.

In future system solutions it will become increasingly difficult to make a clear distinction between a product and a service. In the application, the function and service are mutually dependent, and the service may even be part of the function. Examples of this include maintenance measures in machines and plants on the basis of condition monitoring and remote support. These are the prerequisite for being able to continue operation with optimised conditions.

The integration of Internet-based communication in the industry is playing an increasingly important role in this context. This will result in a lasting change to the working world of those employed there. Automated, service-based communication between system components, and between processes and providers over the Internet will increase enormously in the future. Human involvement will increasingly be of a monitoring and controlling nature, thus making staff qualifications more and more important.

Mechanical and plant engineers, systems integrators, distributors, and the users and operators in the various industries rely on high-quality service and support that provides efficient, application-specific support for the implementation of and interaction between products and systems. They demand reliable solutions that are supported in the field by the manufacturer throughout the lifecycle of the applications.

In the Automation Division at ZVEI, the members of the Service Marketing working group have set themselves the task of defining and describing the range of significant services for customers. Based on uniform terminology, readers receive a guide to the services offered by manufacturers across the entire lifecycle of the products and systems in their applications. Priority is assigned here to product-based services.

The guide presents a phase model in the lifecycle of machines and plants, explains the need for industrial services, describes the future-oriented service portfolio in detail and pinpoints the benefits for customers. Thanks to a description of the added value of these services, customers are able to make industrial services measurable and thus clarify the associated costs.

2. The 5-Phase Model for Industry Services

Coordinated services for each phase of the lifecycle ensure maximum machine and plant availability. This applies equally to the engineering of new and existing machines.

The suppliers of drive system and automation technology (referred to below as 'service partners') work together with their customers to develop the best solution and put their ideas into practice, be it the optimisation of an existing machine or the development of a new machine. The 5-phase model is used here as an example to demonstrate the various possibilities in the area of industry services.

5-phase model for industry services

Planning & Design	Construction & Engineering	Production & Commissioning	Operation & Optimisation	Modernisation
		Online Support		
		Technical Support		
		Training		
Consulting Services				
	Engineering Services			
	Remote Services			
		Condition Based Services		
		Maintenance		
		Field Service		
		Spare Parts & Repair Services		
		Modernisation Services		
		Service Contracts		

Source: ZVEI



2.1. Planning & Design

Well-founded support right from the start

Be it a new or existing machine or plant – the planning and design phase lays the foundations for successful project implementation. Service partners and their customers work together to develop a coordinated concept that incorporates the experience of both parties. In the process, attention is paid to the specifications of markets and industries, directives and standards, as well as approvals and certificates, for instance in the areas of energy efficiency and machine safety.

Software-supported tools increase planning reliability for simulation, component selection, and the design of everything from simple machines through to complex production and process plants. Tried and tested project management and controlling processes ensure transparency for functions, deadlines and the budget throughout the entire project.

Examples of industry services for planning and design

Contract law

- Definition of terms (manufacturer, supplier, etc.)
- Assistance in planning and implementing supplier contracts

Project management

- Transfer of knowledge to partners involved
- Acquisition of project management services

Maintenance strategy

- Planning an early maintenance strategy (reactive or preventive)
- Planning the provision of spare parts
- Taking account of machine running times
- Taking account of regional dependencies and availabilities

Planning of lifecycle costs

- Total cost of ownership (TCO)
 - Spare part availability, discontinuation announcements
 - Upgrade and update cycles

Technology support

- Consulting and engineering for technology issues such as:
 - Network and security
 - Energy management
 - EMC and overvoltage protection
 - Machine safety
- In-depth consulting services taking account of the current directives and legal situation
- Verification and implementation of planning and design



2.2. Construction & Engineering

Professional solutions for a streamlined engineering process

A process coordinated in collaboration between the customer and service partner lays the foundations for developing new machines, for adapting old or third-party machines, and for functional system modifications. Once the requirements specification and functional specification have been drawn up, the interaction between products and systems is defined, and the automation and drive system solutions are planned. Simulation results are transferred to engineering tools. Construction plans, electrical diagrams, statics calculations and switching cabinet designs build on this. The application is developed based on the planned hardware and software, with additional project reliability being provided by building a prototype. Target-oriented planning, product briefings and startup seminars are the final steps taken before successfully commissioning the machine or plant.

Examples of industry services for construction and engineering

- Support for the resources
- Technical support
- Provision of information
 - Online information
 - Operating instructions
- Application development and support
- Implementation and/or support for
 - Creation of requirements specification and functional specification
 - Programming
 - Validation and verification
 - Function tests
 - Logging and documentation
 - Provision of software, tools and applications
- Project management
- Verification of configurations, parameterisation and project design



2.3. Production & Commissioning

Reliable support through to commissioning

When setting up the machine or plant, reliability is the decisive criterion prior to commissioning on site. Competent service partners make a valuable contribution in this phase, too, in that they check the installation and parameterisation, as well as perform function and integration tests both for individual components and for the whole plant. A test run carried out together with subsequent acceptance provides final certainty that the machine or plant is fully functional and provides the opportunity to brief and train the service staff and operating personnel subject to real conditions. After CE marking and any other markings comes final acceptance by the operator at the installation site (please also refer to Machinery Directive 2006/42/EC Art. 2).

Examples of industry services for production and commissioning

- Project management
- Knowledge transfer for operating personnel and service staff
 - Seminars and training sessions
- Technical support
 - Remote support
- Support for verification and validation
- On-site service support
 - Assembly services
 - Support during the startup phase
- Creation of plant-specific documentation



2.4. Operation & Optimisation

Constantly under review: productivity and safety in operation

Reliable machines and plants ensure continuous operation in day-to-day production. This reliability must be subject to constant review. Unscheduled shutdowns and downtimes should be avoided by detecting and dealing with potential sources of error in advance. The performance of machines and plants is enhanced through ongoing improvements, while adherence to rules and guidelines is ensured.

The preventive measures for reliable operation also include defining suitable solutions for possible malfunctions, which restore operation quickly without any long downtimes. The checks and improvements are particularly applicable to older machines.

Examples of industry services for operation and optimisation

Plant availability

- Maintenance (strategy and concept)
- Plans for regular inspections and checks
- Coordinated concept for spare parts deliveries and fast repairs
- On-site repair and fault rectification (field service)
- Qualification of maintenance resources
- Use of remote support
- Verification of IT protection concepts, machine safety analyses (functional safety)

Improved productivity

- Reduction in operating costs
- Assurance of plant performance
- Process and product quality assurance
- Optimisation of energy efficiency
- Transparent lifecycle (costs, planned shutdowns, upgrades)
- Process modification and optimisation

Adherence to rules and guidelines

- Scheduling and timely implementation of new rules and guidelines within the operating phase

Serviceability

- Maintenance of the installed base
 - Condition analyses: stocktaking of machine and spare part stocks, assessment based on durability, replaceability and upgradeability
 - Lifecycle information: regular information to operators including service information regarding their machine or plant



2.5. Modernisation

Reliable operation – subject to constant enhancement

Towards the end of the service life of a machine or plant, it is necessary to decide between the alternatives of new purchase or modernisation. As a rule, constant modernisation is the most economical solution for extending the service life of machines and plants. For a long operating period, this reliably reduces the servicing effort, ensures serviceability and optimises availability.

In addition to constantly reliable operation and planning reliability, the focus is on possible efficiency potential, lower operating costs, as well as extended functions or the implementation of innovations. Substantial changes made to convert an old machine may give rise to a repeated verification of CE compliance.

Modernisation measures comprise services in the planning and design, construction and engineering, and production and commissioning phases:

- Verification
- Design
- Planning
- Implementation
- Project management

Examples of industry services for modernisation

Long-term investment protection

- Assurance of economical operation

Increased efficiency

- Optimisation of lifecycle costs
- Energy saving
- Improved productivity
- Reduction in operating costs

Assurance of availability

- Use of the latest software versions
- Updated material stocks
- Ongoing qualification of service staff

Adherence to rules and guidelines

- Regular risk assessments
- Check for changes in protective devices

Bundling of technologies

- Reduction of product variants, harmonisation, standardisation

Diversification of technologies

- Strategic orientation:
 - Second source
 - Fulfillment of functional requirements
 - Consideration of regional peculiarities

3. Service Categories

The technical services of a service partner or manufacturer depend not only on the service strategy, but also on the type of products and systems that are marketed and for which a service offering exists. Usually, therefore, not all services that are described in these guidelines can actually be found in a service partner's portfolio. Rather, an emphasis is placed on the requirements of machine manufacturers, systems integrators, retailers, machine operators and machine users (referred to below as 'customers'), and on establishing an appropriate, professional service concept with flexible service packages, perfectly aligned with the various requirements in the lifecycle of a machine or plant.

3.1. Consulting services/assessment/audit

There is a broad range of possible consulting services in the area of servicing. Consultant services are primarily required during the 'planning and design' and 'modernisation' phases. They help customers to reduce costs, minimise downtimes, meet deadlines, and plan and implement appropriate qualification measures.



The range of consulting services offered includes binding consultations, assessments, audits and certifications by specialists with regard to issues such as shutdowns, running times, availability, serviceability, safety, economic efficiency, energy efficiency, and the throughput of product or system installations.

Examples of consulting services

Technology support

The main focus of the consulting provided by service partners is on engineering and technology issues such as energy management, EMC and overvoltage protection, machine safety,

and network and IT security (cyber security). Both current and future directives and laws are taken into account. In the ideal case, service partners often play an active role in drawing them up and are familiar with the interpretations early on.

Planning and design verification

With a view to increasing planning and design reliability, service partners support customers in the verification and implementation of machine and plant planning. This gives customers increased certainty with regard to technical implementation and meeting efficiency targets.

Machine check

Service partners take on the task of targeted stocktaking for drive system and automation components, including condition analyses. Upon request, they also provide recommendations for action. This provides the customer with a detailed overview of the installed components, resulting in simplified spare part procurement and a faster response when servicing is required. Moreover, the analyses aid the customer in proactively replacing spare parts during scheduled shutdown times and help to minimise the costs caused by unscheduled shutdowns.

Contract law

In legal matters, the service partners support customers in clarifying various issues ranging from drawing up contracts through to implementing contractual regulations such as supplier contracts.

Project management

This traditional service helps customers to meet deadlines in their projects and stay within the planned budget. The involvement of a reliable service partner ensures that the necessary expertise and any resources required at certain points are available.

Maintenance strategy

External consulting during the development of maintenance strategies has various advantages for the customers: the conditions of their machines and plants become transparent, critical machine and plant parts are identified and unscheduled shutdown times are minimised, thus reducing costs while increasing the availability of the plants. Preventive or reactive measures are taken to reduce operating costs to a minimum. In addition, inventories are optimised for supplying spare parts.

Lifecycle cost planning

The requirements and specifications for operating a plant are highly specific, especially in the case of service lives of 15 years and more. With a view to ensuring the functionality and modernisation of a state-of-the-art plant automation, the service partner offers its customers a professional service concept. On the one hand, this meets the individual customer requirements, while on the other hand, flexible service packages take account of the different requirements in a plant's lifecycle (please refer to section '3.13 Service contracts', subsection 'Lifecycle service contracts' for further details).

Examples of assessments and audits

With increasing plant complexity and intensified cost pressure, the availability and serviceability of automation systems are becoming more and more important for plant productivity. In order for products, systems and services to be perfectly synchronised, a detailed knowledge of the plant condition is necessary so that appropriate plant updates or lifecycle services can be designed and implemented. An assessment or audit provides clarity with regard to the current condition and serviceability of the automation system.

- **Assessment**

A system assessment analyses the current system status based on representative system components agreed on with the customer. This pinpoints any weaknesses with regard to the serviceability of the automation system and detects possible risks.

- **Audit**

In an audit, a detailed system analysis is performed to assess the plant condition with regard to serviceability, upgradeability/updateability and system avail-

ability. Decisions regarding system enhancements, service strategies and hardware/software upgrades are prepared based on the results and the general upgrade risk is minimised. The results of a system audit are documented in a conformance report.

Customer benefits

- Lower operating costs
- Reduced shutdown times
- Strict adherence to deadlines
- High planning reliability
- Reliable provision of spare parts

3.2. Engineering

Engineering services aid the implementation of complex product or system installations. The services may extend to becoming the general contractor for projects. Typical activities include design and dimensioning, interface coordination, parameterisation, as well as software and application development. Engineering services are usually provided subject to a contractual agreement (see section '3.13 Service contracts').



Examples of engineering services

Design/dimensioning

The service partner provides support in designing, dimensioning and selecting the right drive system and automation components for machines or plants. Customers do not need to employ suitable specialists themselves and benefit from optimised technology for their machines. Both current and future guidelines and laws, not to mention efficiency aspects, are taken into account.

Application development and support

Instead of or in addition to their own application resources, customers draw on the expertise and capacities of the service partners. Knowledge of the customer's production processes and other processes as well as specific

drive system and automation expertise give rise to higher machine availability, greater process efficiency and lower operating costs. Moreover, the service partner is available for plant optimisation and modernisation and, in many cases, also for professional project management.

Software development/parameterisation

Services relating to all aspects of software development, programming and parameterisation support customers in developing their machines or plants quickly and on schedule, right up to the reliable commissioning or acceptance of the technology. Here, the service partners can, for instance, be drawn on specifically for project design, verification, and the validation of configurations and function tests.

Some service partners have extended their range of services and offer prefabricated software modules for certain applications and drive system solutions. Customers input their own specific parameters. As a result, they quickly have a solution that is ready for use, thus benefitting from savings in terms of costs, resources and time.

Compilation of documentation

Compiling professional documentation can be a very extensive task, but is absolutely essential. Service partners can create the requirements specification and functional specification or provide support in creating them.

They also provide important assistance with logging and documentation for software, tools and applications. In addition, service partners can assume responsibility for compiling the legal validation documentation for machine safety.

Customer benefits

- Use of specific expert knowledge
- Optimised personnel deployment
- Optimised processes and technologies
- Accelerated developments
- Consideration of the latest guidelines and laws

3.3. Technical support

The technical support specialists deal with all customer queries relating to product and system functions and handling by telephone, e-mail or online support. The services range from basic support, which is usually free of charge, to individual support contracts that can be combined with the online support offers.



The technical support specialists have extensive knowledge of the areas of engineering, startup and system tests. Thanks to their practical experience, they are also competent contact partners in tricky cases. In terms of content, technical support can be divided into three consulting levels:

Product support

- Queries regarding the function and use of individual products

System support

- Queries regarding the interaction between various products
- Topic-specific queries, for instance regarding safety, communication or control technology

Application support

- Queries regarding the use of products and systems to automate industry-specific machines and plants
- Project support
- Script creation and modification
- Project design support and enhancement
- Individual customer solutions/special solutions

Examples of technical support

The various services and options of technical support are aligned with the specific requirements of the users. It may be possible to request them separately or they may be grouped in modules or packages.

Basic support

All service partners offer basic support for their products and systems. This is requested through the usual channels, on working days during the usual office hours. Basic support is particularly suitable for queries that can be dealt with quickly. For more in-depth, complex queries, further service modules can be provided.

Extended technical support

In the case of complex tasks, extended technical support is provided:

- **System migration**
Consulting, creation of project design, support for project design
- **Configuration & health check**
Downloading of PC diagnostic data, analysis and assessment
- **Reproduction of system/plant behavior**
Exact reproduction of plant behavior through complete reproduction of the plant constellation concerned
- **Commissioning support**
Support for automation projects, product briefing, problem analyses

Support contracts for helpline/hotline

With support contracts, technical support can be tailored to the individual needs and different support requirements in the lifecycle of a machine or plant. The technical support services can be agreed flexibly and independently of one another with various options.

- **Support times/availability**

Extended times for the availability of technical support can be agreed beyond the usual office hours. Customer-specific periods or support around the clock, for instance during commissioning, are usually connected to a particular contact person and separate channel.

- **Response times/direct contact**

Depending on what is agreed upon, a technical support specialist may be contacted directly or may be requested to call back. A time limit or a desired callback time may be defined for calling back.

- **Contact person/technical account manager**

A fixed contact person is already familiar with the plant situation beforehand and can therefore respond more quickly to a technical query. An account manager prioritises and coordinates various queries from a customer as part of technical support. Here too, users benefit from time savings.

- **Means of contact/access**

The standard means of accessing technical support are connected with a central phone number, a standardised e-mail address or, in the case of an online query, with the web address of the online support. Customer-specific means of contact can also be agreed via a separate access such as a mobile phone number.

- **Remote support**

Remote support allows fast and effective assistance for remote diagnostics or troubleshooting in the automation system of a machine or plant. Personnel and operating

resources can be put to optimum use, with the result that downtime is minimised.

- **Customer-specific support**

Customer-specific products and systems that are not included in the standard portfolio are supported by technical support as part of a contractual agreement. Customer-specific support also comprises collaboration in projects and in connection with customer-specific standards for a machine or plant.

- **Time and query quotas**

A support contract can be optionally agreed with additional time quotas (block of hours) or a particular number of queries (quantity quotas). Using quotas allows more flexible pricing, while facilitating the procurement of services and settlement for the customer.

- **Proactive support intervals**

Proactive support collects, assesses and summarises experience from support pro-

cesses by means of professional knowledge management. Recognising and rectifying critical conditions at an early stage leads to a direct increase in plant availability.

- **Support for products that can no longer be delivered**

In order to secure investments in the long-term, support is required for products that can no longer be delivered. Depending on the requirements, this may also entail long-term support that is provided even after the regular spare part and repair period for a product has ended (discontinuation announcement).

Customer benefits

- High planning reliability
- Optimised engineering effort
- Maximum implementation reliability
- Fast commissioning
- Increased machine and plant safety

3.4. Remote services

Remote services involve providing services for the customer's plants and products from a different location using appropriate communication technologies. The service provided can range from diagnoses, configuration and parameterisation through to servicing or determining maintenance measures.



Proactive services, multimedia communication and increased service efficiency are key aspects of the remote service. The service partners offer individual service packages for this. The remote service can be implemented using various technologies: via telephone support or online communication as well as by accessing plants with a modem, VPN, VPN server or smart remote platform that allows complex administration.

Examples of remote services

Remote diagnostics

In the case of remote diagnostics, the service partner accesses the customer's system using appropriate communication technologies and diagnoses the problem. This service forms the basis for a remote service contract.

Online communication support

Online communication allows visual communication between the customer and their service partner. The situation on site is transmitted to the service partner by video livestream and the partner gives direct instructions to the customer or their service engineer.

Remote servicing

Remote servicing entails servicing and repairing plants and devices using two systems in separate places. The services range from reading individual plant parameters through to a complete plant check.

Software and configuration update

Many plants and devices require software updates to be performed at regular intervals. In order to ensure smooth plant operation,

subsequent configuration updates may also be necessary.

Proactive servicing

Proactive servicing allows the service partner to act with foresight. By means of diagnoses and remote servicing, knowledge can be gained that aids the customer and their service partner in solving problems. As a result, maintenance, a software update or repair work can be planned and carried out.

Network of experts

The communication options provided by the remote service allow end-to-end coordination between qualified experts from different disciplines as part of a network of experts. Service engineers, product managers and developers can use the remote infrastructure to find a solution to the customer's problem together.

Fault monitoring

Fault monitoring is an elementary area of remote services. Using an appropriate means of communication (text message, e-mail, phone call, etc.), fault signals can be reported to the customer or service partner in order to rectify the fault as quickly as possible.

Customer benefits

- Maximum plant availability and reliability
- Time and money saved by proactively determining the need for maintenance
- Extended services with added value
- Situation-specific, personal consulting
- Increased security by means of analyses, diagnostics and continuous monitoring
- No costs for travel times, per diem allowances, etc.

Technology levels of remote support

Basic level	Technology level 1	Technology level 2	Technology level 3	Technology level 4
Telephone or online communication	Access via modem	Access via VPN	Access via VPN server	Access via smart remote platform

Source: ZVEI

3.5. Condition monitoring services

Condition monitoring services are based on the plant's present operating condition and wear margin. Its operating data is recorded cyclically, analysed using specific algorithms and presented to the customer or service partner in the form of a message or report. The necessary measures are triggered automatically. The result is a reduction in plant lifecycle costs.



Examples of condition monitoring services

Data analysis

The recording of settings and limits lays the foundations for condition monitoring. Limits may be plant wear characteristics, signal transmitters on system components such as shafts, or wear-related measurands.

Data evaluation

The plant parameters gained are evaluated using suitable algorithms in order to determine the plant's operating condition and establish threshold values. The resulting process data and distinguishing features can be used to make meaningful statements regarding plant wear.

eCall

The eCall is a special service button that is positioned in a clearly visible position on the plant. If someone presses it, a request is sent

to the service partner with the relevant data, allowing them to respond promptly.

Continuous condition monitoring

In continuous condition monitoring, a plant's machine parameters are recorded in real time. In this way, both long-term trends and sudden changes in the plant are established. This aids the customer and service partner in optimising the plant.

Customer benefits

- Higher plant availability
- Higher output quality
- Lower operating costs
- No wear-related damage

3.6. Field service/on-site service

The field service or on-site service comprises all services that are provided on customer premises, by qualified personnel with extensive expertise and modern equipment. The services involved can be highly varied.



Examples of field service

Customer support on site

By working directly on site, the service partner ensures the transfer of knowledge, discusses the details of the deployment with the customer, provides advice and information regarding further services, and thus builds up customer trust.

Product-based services, maintenance

Manufacturers offer technical services that comprise the traditional service activities such as servicing, inspection, repair and improvement covering all aspects of machine and plant maintenance.

Servicing and inspection

The measures in conjunction with servicing and inspection aim to protect people and plants, while ensuring uninterrupted machine and plant operation.

Repair

Faults are rectified, components are repaired and products are replaced on site. In addition, the operation of customer-specific applications can be readjusted and further improved.

Improvement

The further improvement of the functional and operational safety of systems is the main focus of this service.

Installation, commissioning

Service specialists provide support for the assembly, installation, commissioning and operational startup of components, machines and plants.

Product-independent services

A wide range of services such as network analysis, bus monitoring, thermography or noise tests focus on issues such as plant availability, lifecycle and throughput, as well as the adherence to legal regulations and directives in areas such as safety, accident prevention and environmental protection.

Service contracts

(please also refer to section '3.13 Service contracts')

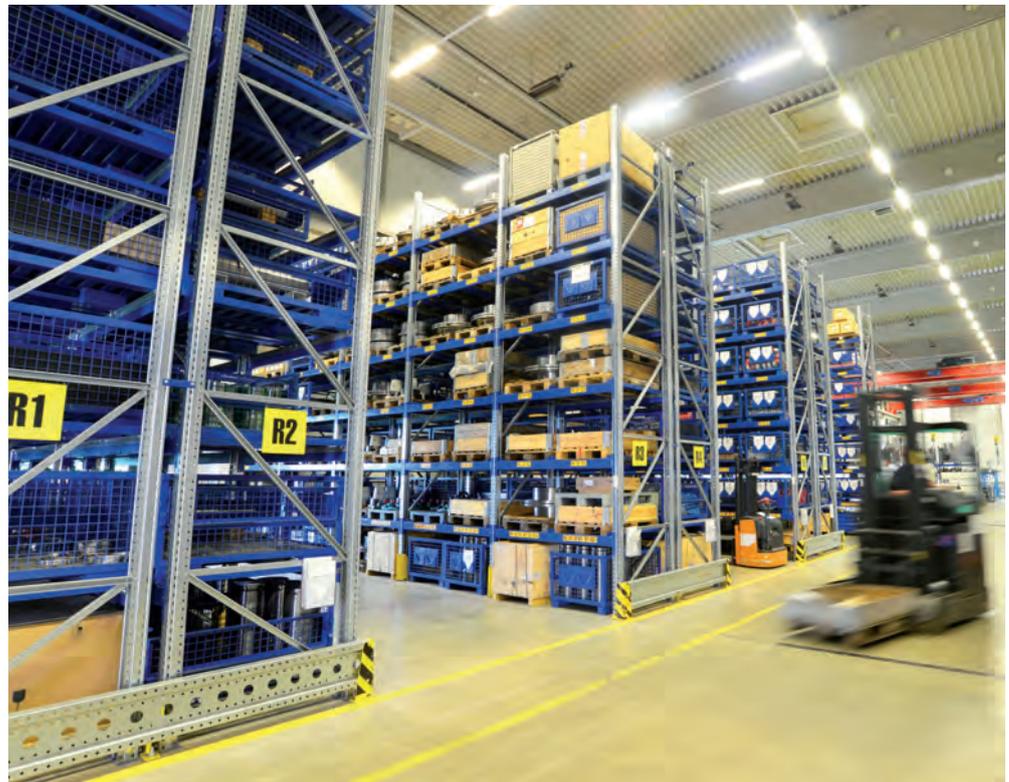
All services can be provided as an individual order or as part of service contracts. The contracts cover not only the service on site, but also agreements regarding availability and response times, and often additionally statements regarding the availability of materials and spare parts packages.

Customer benefits

- Short assembly and commissioning times
- Optimised machine and plant operation
- Increased safety for people and the plant
- Constantly high level of service quality and sustainability

3.7. Spare parts service

The spare parts service entails manufacturing, procuring, providing and delivering spare parts for current and discontinued product ranges over a fixed period of time.



Examples of spare parts service

Spare parts and spare parts packages

Spare parts are components of products (devices, machines or plants) that need to be exchanged in order to maintain or restore the functionality of the product. Manufacturers advise customers with regard to their strategy for the technically appropriate and cost-effective stocking of spare parts.

Expendable parts packages

Components that are subject to wear within the product's normal service life (maximum operating time) are referred to as expendable parts. Usually, they are provided in the form of expendable parts packages for the product.

Replacement products

Replacement products are entire products or devices that are provided in exchange

for defective products. This usually involves repaired or refurbished products, but can also involve new products.

Consignment stock

In conjunction with service contracts, customer-specific spare parts packages are put together. Subject to agreements regarding availability and accessibility, the spare parts are kept available on manufacturer or customer premises.

Express production

Products in the current range that are not kept in stock can, upon request, be produced and delivered as a special express production order. This option is particularly attractive for customers with high-availability applications in the case of complex and high-quality products that are only stored in limited quantities, if at all.

Express delivery

With a view to restoring plant operation at short notice, many manufacturers offer express deliveries for service products.

Service concepts

Service concepts are often drawn up for discontinued products. Based on empirical values taken from the selling period, parts, assemblies and devices are available for customers to order for a defined period of time so that they can restore operation quickly in the event of a fault or error. In individual cases, special production of products for 1:1 replacement is also possible.

Disposal

Upon request, products that have been replaced or sent back are properly disposed of in accordance with the current regulations and standards.

Customer benefits

- Tailored provision of spare parts to minimise storage costs
- Lower maintenance costs
- Increased plant availability

3.8. Repair service

In conjunction with the repair service, defective products and devices are repaired on the basis of cost estimates, fixed prices or subsequent effort calculations.



Examples of a repair service

Inhouse repair

Qualified personnel in the manufacturer's company expertly repair defective products and devices. Specialists from certified workshops or authorised service partners may also be drawn on here.

On-site repair

Qualified specialists rectify faults, repair products and replace components on customer premises. In the process, they may provide advice and assistance for optimised plant operation. Certified service partners also carry out on-site repairs.

Express repair

In the case of express repair, products are expertly repaired either at the manufacturer's company or on customer premises in conjunction with agreed response and repair times. The main focus here is on high plant availability.

Extent of repairs

The customer and the workshop agree on the extent of repairs, also defining what repair work is to be carried out. The decision as to whether the fault should simply be rectified or whether the device should be subject to a general overhaul gives rise to a quotation or cost estimate. In the case of standard repairs, fixed prices are possible.

Upgrade and update

Software is often subject to upgrades and updates. An update rectifies errors in software products and implements minor improvements. An upgrade also includes technical innovations and enhancements that the customer can choose.

Customer benefits

- Increased productivity
- Increased operational safety
- Minimised risks
- Cost control with selectable levels

3.9. Maintenance

Modern maintenance concepts ensure optimum machine and plant availability from an economic point of view combined with full cost transparency. Using a wide variety of products and systems may lead to complex maintenance scenarios. Industrial maintenance is therefore a key task during the operating phase and is carried out with different services depending on the requirements or strategy. Its primary goal is to verify, maintain and restore the defined functions of a machine or plant.



With reference to DIN 31051, industrial maintenance covers a broad range of services, which can be divided into the areas of inspection, servicing, repair and improvement.

Maintenance strategies

Modern maintenance involves three fundamental strategies. Hybrids and variants of these can also be found in practice.

Reactive maintenance (correction)

This strategy revolves around error correction. A fault that occurs is dealt with by means of corrective maintenance (for instance replacement or repair).

Preventive maintenance (interval, quantity, volume)

If the limits of easily measurable variables such as time or quantity are exceeded, defined maintenance measures are triggered.

This usually entails exchanging components prior to possible failure or replacing operating resources.

Predictive maintenance (condition-based)

Although maintenance measures in conjunction with condition-oriented maintenance are comparatively time-consuming, they result in an optimum cost/benefit ratio. What's more, inspection services are provided that allow an overall impression to be gained of a machine or plant. In the case of condition-oriented maintenance, any deviation of the actual condition from the target condition is constantly monitored, and is recorded and displayed using powerful automation systems. The planned maintenance measure for a particular component can be performed immediately or in conjunction with further maintenance measures.

Examples of maintenance measures

The higher-level services in the area of maintenance range from support services through to extensive maintenance measures by the service partner. They also include consulting and support with regard to formulating an overall maintenance concept, as well as keeping stocks for servicing in the sense of an asset optimisation service (please also refer to section '3.7 Spare parts service'), and basic and further training in maintenance.

Inspection

The inspection is of fundamental importance for assessing the actual condition of a machine or plant. This also involves determining things such as causes of wear and establishing suitable maintenance measures. Progressive methods from the area of condition monitoring also provide excellent results. Examples of inspection services include the stocktaking of machines and plants, visual inspections, checks and measurements with documentation (vibration analysis, oil analysis, thermography, performance and consumption measurements, etc.) and software system diagnostics. Analysing errors, evaluating error messages and operating messages, analysing and assessing weaknesses, and deriving necessary maintenance measures are also inspection services.

Servicing

In addition to the measures that are defined in the servicing plans for a machine or plant, further measures are derived from the inspection results. Not only traditional maintenance services, but also modern maintenance services relating to software and applications as well as remote maintenance concepts (remote services) are available. Examples include providing support with planning servicing, determining and documenting servicing intervals, the scheduled replacement of expendable parts and the replacement of consumables. These services also cover the cleanup of

software error buffers, maintaining memory elements (e.g. hard disks), revising the new values of drive system and automation products, and performing express repair and production work.

Repair

Corrective maintenance or fault rectification forms a central module of maintenance services. In conjunction with corrective maintenance services such as error diagnostics, the replacement of defective parts, overhauls, error rectification in application software or remote servicing, it makes sense to provide tailored offers. These concern aspects such as fault registration (availability, callback times), on-call times, service periods, response and arrival times, as well as the settlement modes (please also refer to section '3.13 Service contracts').

Improvement

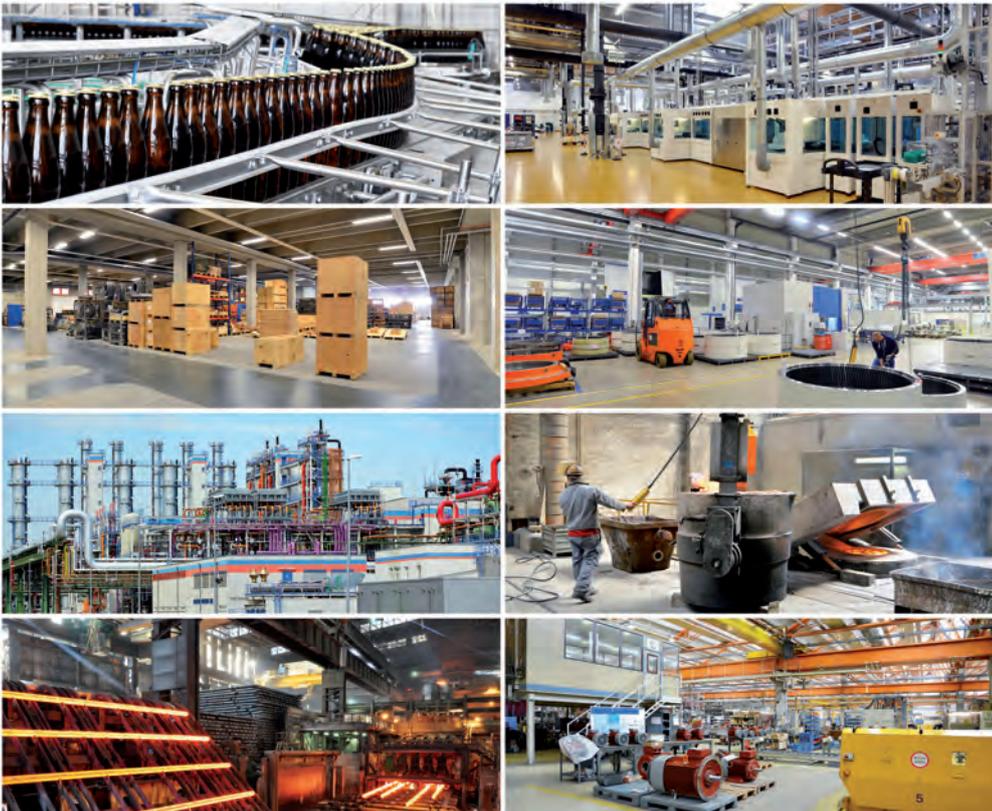
Ongoing plant improvement aims to increase the operational and functional safety of machines, plants and equipment. A particular emphasis is placed here on safety-related aspects and manufacturer compliance. No functional changes or modifications are made during improvement. An inspection of the machine or plant may result in the removal of weaknesses. This involves determining corresponding potential for improvement, developing proposals for solutions and defining measures in an individual maintenance strategy. Improvement therefore differs in terms of content from optimisations or modernisations (please also refer to section '3.10 Modernisation').

Customer benefits

- Increased plant availability
- Increased productivity
- Improved cost transparency
- Fewer unscheduled shutdowns
- Optimum utilisation throughout the entire service life
- Value preservation in plants and operating resources
- Avoidance of lost profits and damage to property
- Improved operational safety
- Assurance of serviceability

3.10. Modernisation

Continuous modernisation entails making investments in improving production efficiency or quality, in preserving the value of plants, in extending or retaining their functional capability, and in ensuring their maintainability. Moreover, modernisation measures ensure that the current legal regulations and guidelines are adhered to.



The modernisation of hardware can take the form of replacing a part (retrofitting), complete replacement or migration to a successor generation. Software is kept up to date by means of an update or upgrade.

Retrofitting or complete modernisation reliably reduces the rising servicing effort that

results from the advanced stage in the plant's lifecycle and increases plant availability. Although the procedures in the process industry often hardly change over decades, economic reasons in particular require outdated technology to be replaced with modern state-of-the-art products that are better adapted to the enhanced process and environmental require-

ments. For example, increases in performance and a higher degree of efficiency can often be achieved through retrofitting measures.

Examples of modernisations

Retrofitting

For existing plants, retrofitting maybe more economical than replacing a plant with a new one. By replacing outdated components and adding modern new technological enhancements, existing plants are made more up to date. The advantage for the plant operator is higher productivity combined with substantially lower costs than for purchasing a new plant. The stable basic substance of the machine is retained and, in the case of large machines, there is no need to invest large sums in replacements for the provision of the necessary peripherals or infrastructure.

Adjustments made over time with a high degree of modification, in particular in the case of control software, may make it necessary to retain the basic system. As a result of the considerable parameterisation and configuration effort, it may be more economical here to simply update individual components.

Complete replacement

The complete replacement of subsystems is the greatest form of intervention in existing plants that is counted as modernisation. Operating requirements with regard to performance, reliability or legal requirements may make this necessary. The distinction between the modernisation of the existing system and the creation of a new plant is fluid, especially when it comes to replacing core components or key functions. It may be more economical here to concentrate on procuring new components while retaining the existing peripherals and infrastructure. This is the main difference compared to a new plant.

Migration

A migration entails changing an essential

part of the systems, for instance switching to a new operating system or new device generation. The migration is therefore not simply an update or an upgrade, but rather a fundamental change of infrastructure. As a rule, a migration also comprises the (partly) automated conversion of programs from outdated programming languages to modern concepts, integration into new systems, as well as modernisation of data storage, the user interface, communication standards or device generations.

Usually, software components or the entire operating system are ported to a newer generation during a migration. Product innovations and further developments to form a new product family or generation may mean it is necessary or makes economic sense to migrate applications and connected hardware, especially with a view to future support options.

Modernisation

Just like the installation of a new plant, a modernisation may be divided into various phases. The tasks of the service partner span everything from consulting, planning and project design to installation, commissioning and training for new components or functions. Moreover, the disposal or dismantling of the old components may also be part of the service. In some cases, there are legal stipulations regarding dismantling and disposal, for instance regulations for disposing of environmentally hazardous substances such as SF₆ gas from switchgear. The support before, during and after the modernisation work corresponds to a certain extent to the services provided when planning new projects, with phases such as project design and engineering being subject to particular requirements by the existing plant.

Customers are also supported by their service partner, for example, in terms of technology consulting. Compatibility with the existing system is particularly important here. The service provider also answers questions

regarding the need to adhere to standards and guidelines and, where appropriate, the need to perform tests to establish whether the modernisation constitutes an essential change as defined in the interpretation paper of the Federal Institute for Occupational Safety and Health (BauA). Apart from the modernisation itself, therefore, the project contains all the phases that can also be found in the planning and implementation of a new system.

Customer benefits

- Often an economically viable alternative to a new plant
- Optimised, standard-compliant plants
- Increased performance and degree of efficiency
- Lower servicing effort

3.11. Online support

Online support constitutes an extensive platform providing information on all aspects of products, systems and services, as well as providing examples of programming, configuration and possibilities for use. On top of this, it forms the central means of accessing further services and contact persons.



As a central platform on the Internet, fully extended online support can be structured in various subareas for service-related content:

- Products and systems
- Applications and solutions
- Services and functions
- Communication
- Service catalog

Products and systems

This area contains the entire range of information offered for all products and systems. This includes manuals and operating instructions, technical catalog data and CAx data, certifi-

cates and approvals, as well as test certificates and characteristics. It also covers answers to frequently asked questions (FAQs) and online help systems as well as updates/upgrades, service packs and support tools. Alongside information regarding versions, details of the lifecycle of products including planned and achieved milestones are also helpful (release for delivery, discontinuation, discontinuation announcement).

Applications and solutions

The focus here is on the user viewpoint, with applications for the interaction between

products and systems. Possible industry solutions are included. A possible structure for the applications and solutions may be as follows:

- **Application examples**

Descriptions of real, functioning and industry-neutral solutions consisting of the approach taken, performance data, project planning instructions and tested program code. Examples of applications may demonstrate a solution to typical automation and drive system tasks and may provide ideas or form the basis for the customer's own solutions.

- **Function modules and tools**

Extensively commented sample programs with ready-to-use function modules that can be used directly in programs in a similar way to standard modules.

- **System descriptions**

General descriptions that explain and compare the possible solutions to certain automation tasks. These documents help users familiarise themselves with the technical background and functional mechanisms of automation components.

Services and functions

Powerful and user-friendly online support provides services and functions that help users to locate the right information, facilitate content navigation, allow users to personalise the information platform and facilitate access from mobile terminals.

- **Search and navigation**

In the case of a free-text search, the system searches through the entire information platform for the term entered. A search algorithm automatically recognises similar or related terms. A tree structure helps users to navigate through the area-oriented topics. An alphabetical index provides assistance in finding clearly defined terms.

- **Personalisation**

To make things clearer and facilitate use, all personal data and information is grouped in a separate area, such as for instance when managing a newsletter or compiling personal documentation.

- **Access from mobile terminals (online support app)**

An online support app facilitates access to the information platform using mobile terminals. This access, which is not restricted in terms of time or location, is an efficient means of supporting the implementation of projects on site, fault rectification, or the planning of new or extended machines and plants.

- **Protected user areas (extranet)**

An extranet entails extending the intranet by adding a collaboration platform on which both the manufacturer and users can store data that is required in order to use and operate products and systems as well as customer-specific machines and plants. Extranets provide a straightforward means of exchanging confidential data across company boundaries and speed up communication between, for instance, the customer and service partner.

Communication

In the function of a communication platform, online support plays a key role in communication among users as well as between users and the manufacturer's or service partner's experts and contact persons. The functions of online communication can be divided into various categories:

- **Technical forum**

A technical forum is used to share knowledge and experience with users from the same or a different industry with regard to the products and systems of the component manufacturer. An emphasis is placed on direct assistance from user to user as well

as on building up expertise through discussion and the exchange of information. One example here is the discussion of a customer-specific problem taking account of various possible solutions.

- **Support query**

When a quick and accurate answer is needed for a technical question, information about products and systems is important. A query can also be submitted directly online to a specialist in technical support. The query can be sent with attachments, and the processing status can also be tracked.

- **Expert chat**

A chat function in online support allows direct contact to be made to an expert in technical support with regard to selected topics. The communication takes place using a monitor and keyboard with a standard web browser. The chat function is useful for simple queries that can be processed quickly and easily.

- **Newsletter**

A newsletter provides information about products, topics and systems that have been defined by personal selection in online support. Personalisation is usually required before it can be used. Sending parameters such as language, format and frequency can often also be set.

- **Twitter and blogs**

Even innovative communication services such as the short message service Twitter or blog articles can be put to good use in online support. Examples here include short messages regarding new services, trade fairs and events, as well as employee blogs.

Service catalog

The offers and information regarding available technical services are compiled in a 'service catalog'. These services may be structured based on clusters that contain similar product-specific services or related portfolio elements. One possible example is a 'Spare Parts' service cluster containing general information regarding spare part availability and processing, offers for spare parts packages for certain product groups and information on innovative services such as asset optimisation services. The service catalog contains detailed content descriptions for the individual portfolio elements, ordering information, a presentation of the possible customer benefits, as well as corresponding marketing documentation and contact persons.

Customer benefits

- Implementation and planning reliability
- Time savings
- Solution for automation and drive system tasks
- Easy access to information
- Exchange of expertise and practical knowledge

3.12. Training

Training sessions and seminars convey product-related, system-related and application-related knowledge and technologies to operators and users (OEM, systems integrators) for installing and operating products and systems. Typically, the knowledge is conveyed by means of standard training sessions within the framework of traditional classroom training, Internet training, or customer-specific, product-specific and plant-specific on-site training.



Training comprises measures that aid participants in learning and developing new and existing skills for using products, and that help to improve performance within certain systems or general functions. The training may involve structured programs provided by the manufacturer or more informal and interactive procedures, such as group discussions for users to share experiences or online seminars in which a large number of users can participate.

A large range of activities are used in training, including courses in classes, training at the workplace, and business games. Means of audio-visual and multimedia support such as videos and CD-ROMs are also used. The training may be carried out by a manufacturer employee or by an external expert on the system or plant.

A training requirement analysis performed beforehand can optimise the effectiveness of training. The same applies to a subsequent assessment of the training by customer employees who later use the products and plants or perform the service.

Customer benefits

- Training in new technologies
- Training in general topics such as functional safety
- Motivation for individual learning
- Improved company performance
- Certification of employees, e.g. to become explosion protection representatives

3.13. Service contracts

Service contracts are frequently applied in all five lifecycle phases of machines and plants. Characteristic of these contracts is their specific formulation between the contracting parties as an expression of individual service and cost structures.



As a rule, recurring services are agreed in the context of service contracts. The services are based on components of the overall portfolio, for instance warranty extensions, servicing in the sense of maintenance, the provision of spare parts (consignment stock), and optimisations and modernisations that are offered either as part of standard contracts or customer-specifically.

Examples of service contracts

Warranty extension

Customers want products that are free of defects. Extending the manufacturer warranty to a longer period of time constitutes an expression of quality awareness on the part of the supplier, while providing users with a means of reducing cost risks. Warranty extensions such as preliminary exchange, fixed response times and short delivery times can be made part of contracts.

Engineering contracts

Contracts are also usually drawn up for the services described in section '3.2 Engineering'.

Support contracts for the helpline/hotline

With support contracts, technical support can be tailored to the individual needs and different support requirements in the lifecycle of a machine or plant. The technical support services can be agreed flexibly and independently of one another with various options (please refer to section '3.3 Technical Support' for further details).

Service level contracts

The aim of service level contracts is to reach reliable agreements regarding the availability and response times of the service partner, for instance for on-site deployments, regarding delivery times and periods of time within which faults must be fully rectified. The contracts are formulated customer-specifically, in line with the respective requirements.

There are various advantages for the contractors: they can base their planning on the agreed timeframes and benefit from transparent costs for unscheduled shutdowns within the agreed timeframes. In addition, in conjunction with other measures, the contractors can use the agreed times to minimise costs in the event of unscheduled shutdowns and avoid production downtime. The customer can cut costs in the event of downtime further through regulations for damage compensation.

Agreements regarding consignment stock

With contracts governing the provision of consignment stock, customers satisfy their wish for minimum capital commitment in storage and faster availability of components in the event of downtime. Both the supplier and the customer should be aware that this service has its price. Parts of the agreements also include, for instance, rights and obligations when stocks are not used, what happens to the products when the contract expires, and measures against aging.

Servicing contracts

Servicing contracts aim to ensure full machine and plant availability without any unscheduled shutdowns. Servicing measures are assumed to be preventive measures taken mainly during the operation and optimisation phase. Service partners input their specific drive system and automation expertise in order to keep the machines and plants in an optimum condition. This reduces risks and thus also operating costs.

This may have a wide range of advantages for customers. Servicing is carried out regularly and professionally and the risk of failure is recognised in good time. A machine breakage can thus be avoided and accuracy can be maintained. Thanks to the longer service life of machines and plants, a contribution is made towards investment protection, while fewer shutdowns save customers lots of money.

Servicing can be easily planned in the long term and is usually performed subject to a flat rate, meaning that travel costs and material are included. Small parts are replaced up to a certain amount, which is credited against additional components to be purchased. A discount is often granted for any extra spare parts that are required. Minor repair work is also possible as part of servicing. Further advantages include clear contractual clauses and straightforward termination.

Lifecycle service contracts

The requirements and specifications for operating a plant are highly specific, especially in the case of service lives of 15 years and more. Accordingly, service requirements differ greatly. Together with their customers, service partners lay the foundations for the core areas of investment protection, system availability, modernisation and servicing costs, discontinuation management, migration cycles and upgrades.

With a view to ensuring the functionality and modernisation of a state-of-the-art plant automation, service partners offer their customers a professional service concept. On the one hand, this meets the individual customer requirements, while on the other hand, flexible service packages take account of the different requirements in a plant's lifecycle. The service concept contains proactive lifecycle services that can be combined with contract options regarding aspects such as contract term, arrival times, response times, spare parts management or secure remote access.

A lifecycle service contract has the advantage of lower total costs of ownership (TCO) combined with predictable costs for servicing and modernisation. In addition to ensuring serviceability, it is ensured that spare parts can be delivered in the long term while plant availability is optimised.

The planned update cycles of the products and systems used particularly influence costs and

availability in the long term. Service partners offer well-grounded consulting throughout the plant's entire service life. The focus is on the total cost of ownership (TCO), in other words the costs that are incurred throughout the entire lifecycle of the machine or plant. Thanks to their expertise and experience, service partners can help their customers to determine the TCO and develop suitable life-cycle service concepts.

Customer benefits

- Reliable basis for planning
- Reduced cost risks
- Avoidance of production downtime
- Fast availability of services and spare parts
- Lower operating costs
- Investment protection

CAPEX vs. OPEX

The calculation of TCO includes both investment costs (capital expenditure, CAPEX) and operating costs (operational expenditure, OPEX). CAPEX comprises acquisition costs, engineering costs, and expenditure for installation and commissioning. Once the plant is in operation, costs are incurred not only for things such as raw materials, operating materials, personnel, leasing and energy, but also for maintenance and repairs. During plant optimisation or modernisation, moreover, there are further costs for engineering and support. Last but not least, a plant's aging process is combatted with active obsolescence management (replacement of discontinued components) and planned modernisations, which give rise to substantial costs. OPEX may therefore be several times as high as CAPEX in the course of the plant service life.

4. Summary and Outlook

The members of the Service Marketing working group of the Automation Division at ZVEI have set themselves the task of defining and describing the range of significant industrial services for customers. The focus here is on customer benefits. The general description of the added value of services makes industrial service measurable and thus comparable for customers. These guidelines describe an extensive service portfolio in detail and are intended to serve as an orientation guide for companies. The phase model described for the lifecycle of machines and plants illustrates the demand for industrial services.

The phases presented make it clear that service is essential for the ongoing and efficient operation of industrial machines and plants. In view of the high degree of complexity and depth of integration in current systems, the perception that service or traditional customer service serves simply to rectify faults is rather outdated. As automation and the networking of production plants progress, the role of service will change such that regular checks and updates, also by remote diagnosis, become an integral component of operation.

The suppliers of drive and automation systems now offer services that span the entire lifecycle of products and systems. For users and operators, this increases the safety, availability and productivity of the systems. Carefully selected services pay off for companies over the useful life of machines and plants.

Smart Services with Industrie 4.0

This trend will be further intensified in the future, as Industrie 4.0 is promoting the digitalisation of products and processes. The resulting quantities of data (Big Data) are laying the foundation for new, data-supported services and business models.

Traditional services are being combined with Internet-based services to create innovative smart services that are available flexibly and in line with requirements. This is giving rise to fundamental changes for the industrial environment of factory automation and process automation. Smart services with digitised and networked products, processes and services not only lead to efficient production, but also optimise complex value chains.

This creates the potential to increase the availability and productivity of industrial machines and plants. The future implementation of these Industrie 4.0 smart services will sustainably support the competitiveness of assemblies and plants.

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