



# Medical technology

## Electromedicine driving healthcare

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Innovative products form the foundation for the international success of electromedical technology in Germany. This is shown both in the strong sales achieved by the German medical technology segment compared with other industrial countries and the export share of more than 70%, which even surpasses the already high average for the electrical industry. Innovations in Germany benefit from positive general conditions, especially in terms of infrastructure and the pool of skilled labour. The segment plays a pivotal role in the healthcare business, driving employment and growth.

**Close links between medical technology and innovative sectors.** The segment with its products and solutions for clinical challenges is a key component of modern healthcare infrastructures. Electromedical systems will help to achieve further quality improvements and reduce costs by optimising processes in hospitals and beyond. They thereby respond to demographic shifts and the resulting new care requirements. In addition to the inpatient and outpatient sectors a third pillar is emerging of mobile care/home care.

**Remuneration system slowing the growth of the German healthcare market.** Innovation in the healthcare system is hampered by the time and effort involved in drawing up the cost/benefit analyses that are required for innovative methods to be introduced. Temporary public-sector financing of new methods could help to remedy these shortcomings. Another problem is the artificial separation of remuneration systems. It prevents the integration of treatment methods and patient-oriented care by dividing up the treatment process unnecessarily into individual episodes instead of enabling holistic healthcare management. The basis for this would be a cross-sectoral remuneration system.

**The dual system in hospital financing is holding back growth in sector.** Healthcare policy should further reduce the investment-dampening statutory separation between the provider of the investment costs and the provider of the operating costs. An investment component should be anchored in the flat rate payments per case in the diagnosis-related groups (DRG) system. Special agreements with the payers could augment this system as required. If the financial situation of the healthcare facilities also improves with the legal framework, projects that have been postponed for long periods could be implemented more quickly.

**For both 2012 and 2013 we forecast a real increase of 5% in the sales of medical technology 'Made in Germany'.** This projection is also based on the expectation that mainly in the international arena expenditure on healthcare is set to rise. The areas receiving this spending will be both modernisation and the setting-up of new care structures.



## ZVEI

The ZVEI – Zentralverband Elektrotechnik- und Elektronikindustrie e. V. – is the central association for the electrical engineering and electronics industry and it represents the common interests of its 1,600 member companies at the national and international levels. Together with its partners the ZVEI is actively involved in shaping the conditions for the growth and the innovative strength of Germany's electrical sector in international competition. With its representative office in the capital Berlin and a bureau in Brussels the ZVEI has a presence on the ground where the political opinion-forming process takes place. Its office in Beijing is the representation for the European electrical industry.

The ZVEI's centres of competence are thematic platforms that combine the knowledge of the electrical industry on electromobility, embedded software & systems, health management and smart grids.

Further information is available at: [www.zvei.org/](http://www.zvei.org/)

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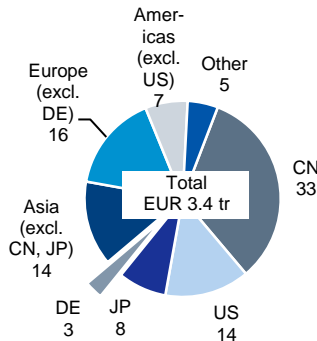
Electromedicine driving healthcare

## Electromedical technology: One of the biggest segments in the German electrical industry

China is the biggest market

1

Global market electrical industry, 2011 (%)



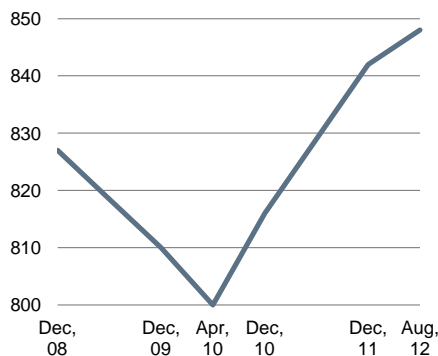
Source: ZVEI, 2012

Electromedical technology (electromedicine) is a key component of modern medical care and comprises the large product groups of imaging systems, patient monitoring and a range of therapeutic technologies. As a highly innovative segment it is at the cutting edge of technology within the German electrical industry – and its importance is growing. On an international comparison, the position of this segment has been constantly expanded over recent years. Although its sales and production share of the whole electrical industry appears to be on the low side, it does play a key role in the healthcare system's processes and in the healthcare market on account of its economic scope.

At a high level

2

Employees in German electrical industry ('000)



Source: ZVEI, 2012

### German electrical industry – dynamic and innovative

First of all with regard to the electrical industry as a whole: the range of products offered by the electrical engineering and electronics industry (electrical industry, for short) is extremely diverse. In the internationally harmonised ISIC (International Standard Industrial Classification) statistics electrical industry products can be found in nearly 30 different classes, at the so-called 4-digit level.<sup>1</sup>

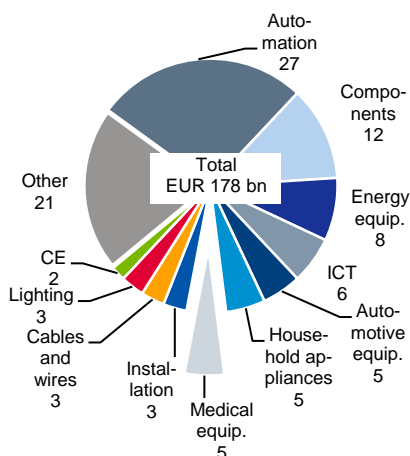
With a volume of EUR 3.4 tr the global market for electrical and electronic products and systems is the biggest product market worldwide. Two-thirds of global electrical manufacturing now takes place in south-east Asia. 17% of the world's manufactured electrical products come from Europe (14% from the European Union), 11% from North America and 3% from Latin America. From a market point of view (in which: market = output minus exports plus imports) Asia currently represents 55% of the global electronics market. Nearly one-fifth of the global market is taken by Europe (14% by the EU) and 21% by the US.

With 848,000 employees (as of end-August 2012) the German electrical industry is the second biggest industrial sector in the country. 20% of its employees are engineers, while another 60% are skilled workers. Since April 2010, when the number of employees fell to 800,000 because of the financial and economic crisis in 2009, the sector has thus created 48,000 new jobs. In general the German electrical industry is made up of small and medium-sized enterprises: 90% of firms have fewer than 500 employees. In addition to staff in Germany there are a further 659,000 employees at electrical manufacturers outside Germany that are wholly or partly owned by German proprietors. The electrical sector is responsible for 12% of total industrial output in Germany. It directly generates 3% of Germany's gross domestic product (GDP).

Broad-based product portfolio

3

German electrical industry products by share of sales, 2011 (%)



Source: ZVEI, 2012

The German electrical industry's product portfolio is as diverse as it is innovative and dynamic. Nearly 80% of manufactured products and systems are capital goods (for instance in the automation, energy technology or electromedical technology segments), 12% are intermediate goods – especially electronic components and semiconductors – and 10% are consumer goods such as electrical household appliances or consumer electronics.

Firms in the electrical industry are quicker than others at turning new ideas into marketable products. For instance eight out of ten electrical companies regularly bring out product and process innovations, and 40 cents out of every euro of sector sales are generated with product innovations that are no more than three years old. One in three innovations in manufacturing is initiated by the electrical

<sup>1</sup> The sector is captured mainly in the two divisions 26 ("Manufacture of computer, electronic and optical products") and 27 ("Manufacture of electrical equipment") – wholly or partly – in classes 18.20, 23.43, 28.21, 28.24, 29.31, 30.20, 32.50, 33.13, 33.14, 33.20.

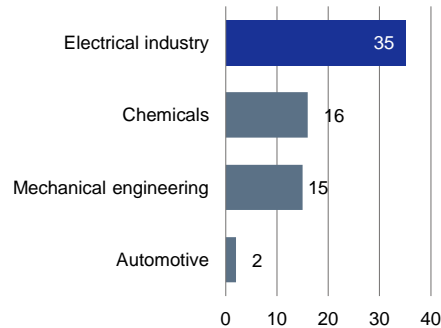


## Electromedicine driving healthcare

### Electrical industry is particularly innovative

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Impetus for innovation in manufacturing,  
% share from ...

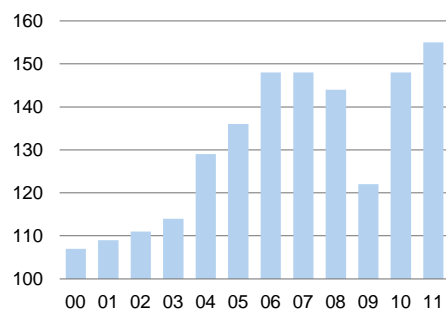


Sources: ZEW, ZVEI, 2012

### At an all-time high

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Exports by the German electrical industry  
(EUR bn)

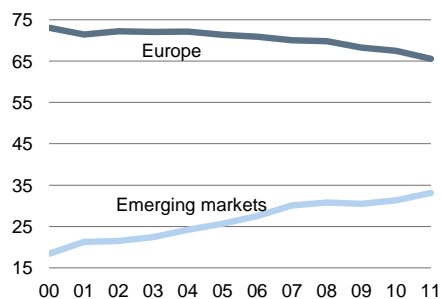


Source: ZVEI, 2012

### Emerging markets gaining importance

6

German electrical industry exports as  
a share of total exports, %



Source: ZVEI, 2012

industry. This means that the electrical sector not only brings out its own innovations, it also provides the impetus for innovations that are then developed elsewhere in the industrial sector.

The basis for the innovative strength of the German electrical industry is annual capital investment of EUR 6 bn, spending on research and development (R&D) of nearly EUR 13 bn and spending on training and further education of EUR 2 bn – thus making combined investments in the future of more than EUR 20 bn or well over 10% of the sector turnover.

In 2011 the sector generated sales worth EUR 178 bn, thus nearly making good the losses accrued due to the crisis in 2009. It therefore accounts for 10% of the total industry sales in Germany. Exports are of particular importance for the German electrical industry. The sector achieved record exports of EUR 155 bn in 2011. The electrical industry accounts for one-seventh of all German exports alone.

The weightings in the export portfolio of the electrical industry have shifted significantly in recent years. Whereas in 2000 more than 80% of all sector exports still went to the group of 34 industrial nations (as defined by the IMF) and only 18% went to emerging markets, in 2011 the German electrical industry was already selling one-third of all its exports in the fast-growing emerging markets. Accordingly, the share of its exports heading to the industrial nations has fallen to two-thirds. The weightings are likely to shift further towards the aspiring economies in future. In 2011 the 11% yoy rise in electrical exports to the emerging markets was more than five times higher than the increase in such exports to industrial countries (+2%).

In the country ranking of the most important buyers of German electrical exports there have also been a number of shifts of late. The US has now assumed the position that had been held by France for decades as the biggest customer. China now occupies third place.

Some two-thirds of sector exports are, however, still sold in Europe, with 50% thereof – or one-third of all exports – in the eurozone. Eight of the top ten destinations are European countries. Accordingly, the economic and political developments in Europe continue to be a quite substantial factor for the German electrical industry – even though ten years ago three-quarters of all exports by the German electrical industry were still heading for European destinations.

## German electromedicine is heavily geared towards exports

Global production of electromedical products and systems (registered statistically in the ISIC classes 2660 and parts of 3250)<sup>2</sup> – and thus also the global market volume – amounted to EUR 80 bn in 2010. This is an increase of EUR 33 bn or 70% compared with just 10 years ago. The Americas and Asia each account for one-third of global production, while Europe's share is 29%. In market terms the Americas constitute 35%, Asia 32% and Europe 26%. With a volume of more than EUR 22 bn the US is the biggest single country market for electromedical technology. It is thus larger than all of the next biggest markets – Japan (EUR 7.1 bn), China (EUR 5.6 bn), South Korea (EUR 4.5 bn) and Germany (EUR 3.4 bn) – put together. The European market in total has a

<sup>2</sup> This statistical definition essentially consists of the following product classes whose properties are not all intended to be expounded upon in this report: conventional X-ray machines (mobile/ fixed), computer tomography scanners, radiotherapy machines, magnetic resonance imaging equipment, ultrasound diagnostic systems, conventional nuclear medicine equipment and positron emission tomography machines, endoscopes, electrocardiographs, blood pressure monitors, patient monitoring devices, ozone, oxygen or aerosol therapy devices, anaesthetic appliances, pacemakers, ultrasound therapy devices, hearing aids, dental drills, artificial kidneys, massage equipment.

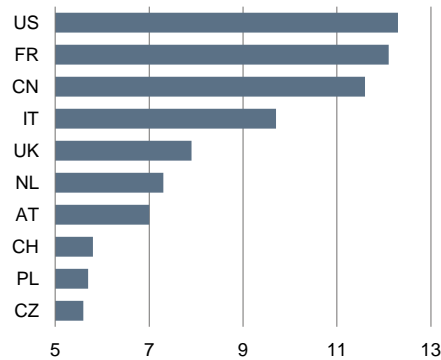


## Electromedicine driving healthcare

China is one of the three biggest clients

7

German electrical industry exports by client nation, 2011 (EUR bn)

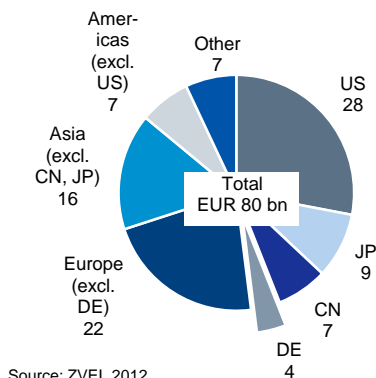


Source: ZVEI, 2012

US still No. 1

9

Global electromedicine market, 2010 (%)

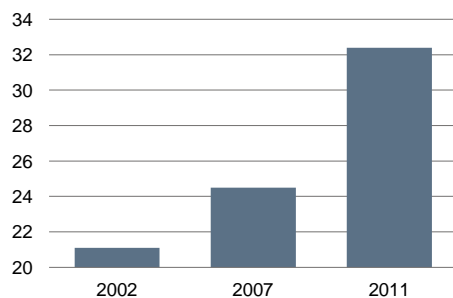


Source: ZVEI, 2012

Electromedicine driving job creation

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Employees in German electromedicine sector ('000)



Source: ZVEI, 2012

volume of EUR 20.2 bn. In 2001 the US was already the biggest single market for electromedical technology with a volume of EUR 16.4 bn, followed by Japan with EUR 5.1 bn, Germany with EUR 2.9 bn, the UK with EUR 2.1 bn and France with EUR 1.8 bn.

It started with Conrad Röntgen

8

The discovery of X-rays in 1895 by Wilhelm Conrad Röntgen heralded the beginning of the age of diagnostic imaging in medicine. For the first time it thus became possible to make bones visible – and subsequently also organs in the human body – without having to open them up in an operation. X-ray technology, or radiography, was thus already available at the start of the 20th century, providing a projection method that has retained its importance in the healthcare system to this day. Angiography and the use of contrast media considerably expanded the range of applications for the technology. In the most advanced application of X-rays, CT scanning, three-dimensional images are generated by rotating an X-ray source and a detector around the patient. With the newest of the three primary technologies, magnetic resonance imaging (MRI), which has only been widely used since the 1980s, the patient is surrounded by a strong magnetic field. An additional weak magnetic field agitates the protons in the body's water molecules. The targeted agitation of these molecules enables differing water levels and thus diverse tissue structures to be viewed. By contrast, the non-radiating and dynamic process of ultrasound diagnosis has already been in use for over 50 years. The technique on which it is based is the reflection of sound waves, and unlike CT and MRI scans it produces cross-section images in real time.

With turnover of nearly EUR 9 bn in 2011 the electromedical technology segment constitutes 5% of all sales by the German electrical industry. In the last ten years sales of electromedical equipment have nearly doubled. The dominance of foreign business, making up 74% of total sales then, is slightly less than is now the case at 78%. This means that the emphasis on exports is even more pronounced – in contrast to the electrical industry as a whole. The electromedical business currently employs 33,100 people in Germany. This is equivalent to about 4% of all employees in the electrical industry. Within a decade the electromedical segment has created 12,000 new jobs in Germany. This is an increase of more than 56%. While the electrical sector as a whole generates annual sales of EUR 211,000 per employee, the medical technology segment achieves per capita sales of EUR 276,000 per year.

Like the electrical and electronics business as a whole, the German electromedicine segment has an extremely strong international focus. In particular the business with non-EU countries is becoming increasingly important (see chart 14). The sector expects the number of medical interventions and thus also the expenditure on healthcare to continue rising worldwide (see chart). This expectation is based on the positive developments that can already be observed, particularly the trade with emerging markets in Asia and South America, as well as the trade with Russia and the US, which have made improving the fulfilment of their population's medical care needs a part of their political agenda – with all the country-specific differences in demand patterns.

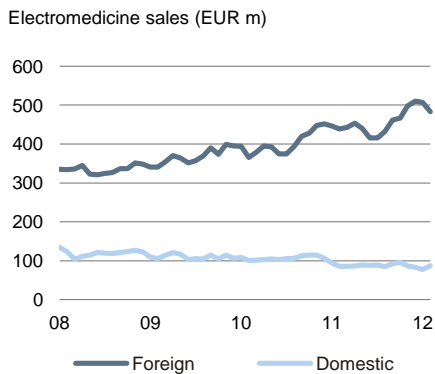
In 2011 German electromedical technology firms exported products and systems worth EUR 10.8 bn,<sup>3</sup> which represents 7% of all German electrical industry exports and is precisely twice as much as a decade ago. This contrasts with imports into Germany worth EUR 5.4 bn. 46% of sector exports – that is around EUR 5 bn – are sold in Europe, 28% in the US (EUR 3 bn) and 21% in Asia (EUR 2.3 bn). In 2002 Europe was still the destination for 47% of exports,

<sup>3</sup> The sector exports of EUR 10.8 bn are much higher than the turnover of EUR 9 bn due to the fact that turnover is only reported by those firms whose activities are focused on this business segment. Non-specialist companies that also produce small volumes of electromedical technology do not see their sales of such equipment included in the sector statistics. The export figures, by contrast, include besides so-called re-exports (i.e. exports of imported products that have been processed only minimally or not at all) also all cross-border goods flows, regardless of the particular sector to which the exporting company belongs.



## Electromedicine driving healthcare

### Foreign business driving growth 11



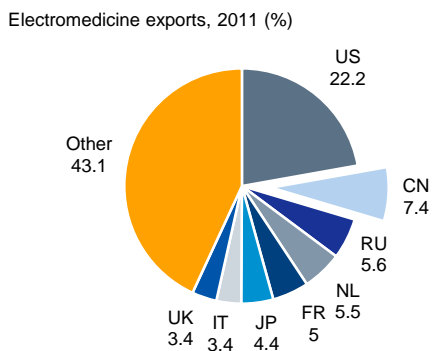
Source: Federal Statistical Office, 2012

and one-third of exports went to the US, while Asia with a share of just 18% played an even smaller role for the sector's exports than today.

The country that buys the most electromedical technology from Germany remains the US with a 22% share of total sector exports – a long way ahead of China (7%), Russia (6%) and France (5%).

With exports of EUR 5 bn Germany thus serves 29% of the entire European market (total market excluding Germany: EUR 16.9 bn). Compared with 2001 the German electromedicine sector has thus improved its market share by 8 percentage points. Furthermore, German exports to Asia have quadrupled in the last 10 years. While during the same period the Asian market for electromedicine expanded from EUR 11.7 bn to EUR 25.4 bn, and has thus more than doubled, the German market share was boosted further from 7% to 9%. The German industry has also managed to significantly improve its position in the US market for electromedical products and systems. It has grown its share of the US market, whose current volume is EUR 28 bn, from 6½% in 2001 to 10½% in 2010.<sup>4</sup>

### China in second place 12



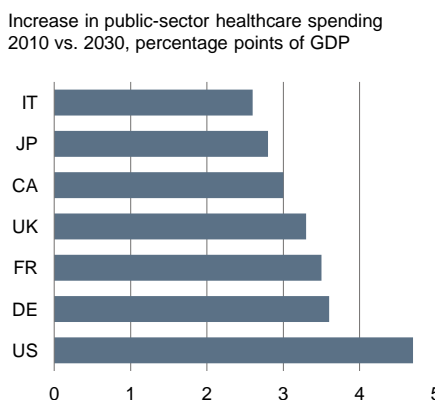
Source: ZVEI, 2012

## Electromedicine: Drivers, trends and opportunities

As stated in the preceding chapter, the electrical equipment in the healthcare segment comprises a broad range of products and processes that save lives, cure illnesses, provide relief and improve the quality of life of patients around the world. On top of this, the electromedicine sector is an important factor for the economy as a whole and for the long-term financial viability of the healthcare system. According to estimates, advances in medical technology alone in the period 2000 to 2008 have generated direct cost savings of EUR 22 bn in Germany.<sup>5</sup>

These potential cost savings can be realised by using among other things modern electromedicine to optimise, speed up and give an interdisciplinary structure to the process chain of diagnosis, therapy and rehabilitation. Electromedicine has thus become an indispensable element of the technical infrastructure for modern healthcare. The technology boosts the efficiency of the processes in the health sector, enhances public health, reduces the length of stay of hospital patients<sup>6</sup> and enables the provision of care at the best “location”. This happens, for example, by no longer administering care on an inpatient basis but instead – when this appears to make sense – on an outpatient basis and not least also via the “third pillar” of home care. The technology helps to break the cycle of spiralling costs in the healthcare system and nevertheless to guarantee fulfilment of the exacting and increased demands made for care.

### Without changes to the system costs will rise sharply 13



Source: IMF, 2010

<sup>4</sup> The position of electromedicine in foreign markets (or rather its market position) has been calculated solely on the basis of exports from Germany to each of these markets. Any additional local output could not be incorporated.

<sup>5</sup> These direct costs refer to the capital employed directly in healthcare for medical treatment and rehabilitation measures (incl. administrative costs). By contrast, the indirect costs of illness represent the inputs lost indirectly due to the illness (e.g. as a result of incapacity for work, disability and early death). Quantifying these costs is often very difficult. See Henke, Klaus-Dirk et al. (2011). Innovationsimpulse der Gesundheitswirtschaft – Auswirkungen auf Krankheitskosten, Wettbewerbsfähigkeit und Beschäftigung. Berlin.

<sup>6</sup> For example, Stephanie Domer finds that the average length of stay following a total hip endoprosthesis implant can be reduced from 13.5 to 7 days by using the latest medical technology. See Domer, Stephanie (2009). Ergebnisse in der mittleren Rehabilitationsphase nach Hüfttotalendoprothesenimplantation in MIS-Technik im Vergleich zum Standardverfahren. Inauguraldissertation. Bochum.



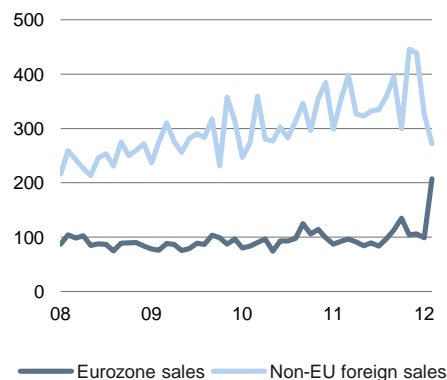
## Electromedicine driving healthcare

Convergence in recent times

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### Sector geared for innovation

Electromedicine, foreign sales (EUR m)



Source: Federal Statistical Office, 2012

The German electromedicine sector benefits from its innovation intensity to an even greater extent than the electrical sector as a whole. Most of the filings made at the European Patent Office are in the medical technology field; the number of applications currently being filed is twice as high as 10 years ago. Accordingly, German manufacturers generate roughly one-third of their sales with products that are three years old at most. Companies in Germany invest roughly 9% of their sales in research and development – double the average for the manufacturing sector. Compared with their US competitors this may still be a small share, but the R&D investments made in Germany are evidently deployed very efficiently. Innovative products can very quickly gain regulatory approval within the EU-wide legal framework of the Medical Devices Directive (MDD) thanks to a testing procedure that involves less red tape than in the US. Accordingly, Josh Makower et al. have found<sup>7</sup> that – compared with their US competitors – companies in Germany gain regulatory approval for their medical technology products employing as little as one-sixth of the capital and up to three years earlier.

Another reason for this innovative capacity is undoubtedly the structuring of the innovation process. For Germany it is typical that there is a close connection between industry, scientists and users. As expounded further below, one particularly widespread phenomenon in Germany for example is alliances with lead users, i.e. trendsetting users, whose actions show the way for developments in the mass market. According to a survey by the association Spectaris 72% of medical technology firms stated that they market their products in such alliances – especially together with doctors and medical care staff.<sup>8</sup> The success of this measure comes on the one hand from inquiring after the requirements of users, while on the other, from the word-of-mouth recommendations of satisfied users in relevant forums.

Modern electromedicine needs reliable modern communication networks

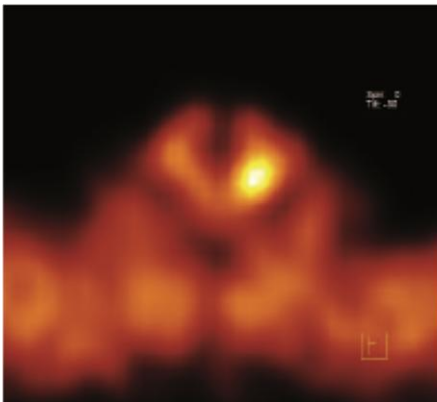
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The electromedical products in use increasingly rely on dependable, high-performance communication networks, especially in rural areas. However, capacity shortages in the data network are not a vision for the future but are set to become a reality in the near future on account of the constantly rising volume of IP traffic.

Recognising the social and economic significance of sufficient broadband capacity, the European Commission has formulated ambitious objectives for expansion that entail huge investment. Germany has raised the bar even higher for itself and is aiming for an internet access speed of 50 Mbit/s for all German households by 2018. Achieving this objective will require major efforts especially in the predominantly rural states of eastern Germany. The European Investment Bank (EIB) in its relatively conservative estimates arrived at a figure of more than EUR 220 bn that would therefore need to be invested in the European Union as a whole (see Heng, Stefan (2012). Net neutrality: Keep calm and don't demonise differentiation“. Deutsche Bank Research, Talking point. Frankfurt.)

<sup>7</sup> See Makower, Josh et al. (2010). FDA impact on U.S. medical technology innovation: A Survey of over 200 medical technology companies. Stanford.

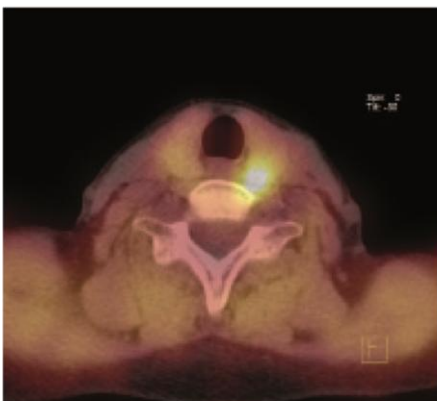
<sup>8</sup> See Bohnet-Joschko, Sabine und Jandeck, Lisanne M. (2011). Erfolg durch Innovation: Das Innovationsmanagement der deutschen Medizintechnikhersteller. Berlin.



The functional data generated in a PET scan ...



... are more informative if they are combined with the morphological information from a CT scan.



Ideally this is conducted in a single examination with a so-called PET-CT scan.

Source: Siemens AG Healthcare Sector

*Case study 1: Widespread innovations in electrosurgery*

The tight cost situation in the healthcare system makes it necessary to provide surgical users with the optimum instruments that guarantee swift and reliable therapeutic success and minimise the costs thereby incurred. With every surgical procedure the primary concern is stopping bleeding safely and swiftly. By ensuring a rapid recovery this delivers a major benefit to the patient and an economic benefit to the hospital.

Stemming the blood flow after tissue dissection without having to change the operating instrument represents another benefit that reduces the duration of operations and thereby cuts costs. Costs can be reduced further by not using disposable items such as clips or stitching material. For some time now bipolar high-frequency current has been successfully used to safely and rapidly seal blood vessels and tissue clusters. Since wounds heal faster and both complications and treatment costs are considerably reduced, the hospital benefits in many respects.

Another technique that is being widely used with success is water-jet dissection in which a fine pressurised jet of water is generated in order to dissect tissue. Using the water-jet generation principle has enabled compact, light and easy-to-use systems to be developed. One principle-based benefit of water-jet dissection is that different types of tissue have differing sensitivities to the water jet and the associated possibility of removing certain types of tissue while leaving other types unaffected by regulating the pressure or flow volume of the water jet. Using a natural medium, such as physiological saline solution, to dissect tissue ensures that the biological cell balance is not damaged. The application itself, that is the spraying of the jet of liquid, does not generate any thermal side-effects (see ZVEI, Spectaris et al. (2010). Das Einsparpotenzial innovativer Medizintechnik im Gesundheitswesen. Berlin).

*Case study 2: Potential for cancer treatment using PET/CT*

If one examines the diagnostic and therapeutic options relating to cancer and their impact on costs in the healthcare system, the difficulty in reconciling the growing number of medical treatments with the limited societal will to fund these services becomes clear. Major advances are being made in early diagnostics and in the precise monitoring of therapeutic success. In this context, Positron Emission Tomography (PET) is one of the most expensive imaging procedures in modern medicine. In Germany, a whole-body PET/CT scan using a hybrid PET/CT machine costs more than twice as much as a whole-body MRI scan, for example.

The statutory health insurers in Germany bear the costs of a PET scan, unlike their counterparts in other European countries, as a rule only if the patient is admitted to hospital and treated there on an inpatient basis. Statutory health insurers in Germany have paid the costs of diagnosing non-small cell lung cancer (NSCLC) since 2007 and also of small cell lung cancer since 2009; however, since such cases are still not included in the list of authorised benefits routine invoicing remains difficult. The Federal Joint Committee (Gemeinsamer Bundesausschuss) has designated an outpatient PET/CT scan for an unspecified residual tumour as a standard service for members of the SHI scheme.

**Positive rating for Germany as a business location**

Such a fast rate of innovation can only be achieved if there is a confluence of several favourable conditions in a location. Besides the legal framework and state subsidies in Germany there are also the factors labour and infrastructure. In addition, more than one-third of electromedicine firms in Germany benefit from public R&D funding. Allied to this, one attribute in Germany's favour is its pool of well-trained skilled personnel that is suited to knowledge-intensive electromedicine, ranging right through to highly specialised engineers and doctors – albeit not always in every discipline or in sufficient numbers at every location. On the journey from innovation to regulatory approval electromedicine benefits from its close links with associated productive sectors – in Germany especially with mechanical engineering.

In addition to its labour force Germany is undoubtedly also characterised by its good infrastructure. The traditional infrastructure segments such as energy and





## Electromedicine driving healthcare

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transport are the first ones that come to mind. For example, the manufacturing of electromedical products relies on grids that guarantee an uninterrupted power supply. Physical goods then require a sufficiently good and comprehensive transport network (especially road, rail and air) to progress further within the value chain. In this respect Germany can undoubtedly earn good marks as a manufacturing location with its infrastructure and most definitely also its central location in Europe.

### Electromedicine needs advanced networks

Besides these traditional infrastructure areas the importance of high-performance data networks is growing. One key requirement particularly in globally structured knowledge-intensive sectors such as electromedicine is that information can be sent quickly and reliably (see box 15).

Accordingly, electromedicine firms award high marks to Germany as a place to do business. A current survey conducted by BVMed – a medical technology trade association – into Germany's good attributes produced the following responses: 58% of firms cited infrastructure, 47% mentioned rapid regulatory approval, 44% well-trained doctors and 42% the high quality of clinical research.

## Several trends driving development

The boundaries are becoming blurred between electromedicine and IT, biotechnology, optical technology, nanotechnology, microsystems technology and microelectronics. Areas of application are opening up particularly in the medical subsegments of orthopaedics (e.g. spinal surgery), cardiology (e.g. minimally invasive surgical procedures) and internal medicine (e.g. endoscopy). This is shown for example in electromedical intervention<sup>9</sup> (e.g. voice-activated robotic-assisted surgical procedures), neuroengineering (e.g. implanted neurostimulation to treat Parkinson's disease or epilepsy), cell and tissue technology (e.g. heart valves that grow with the patient), new imaging procedures (e.g. phase contrast X-rays) and telemedicine (e.g. computer-aided diagnostics and therapy planning). The relevant drivers, which can be categorised under efficiency and mobile technology, will be looked at in greater detail below.

### Efficiency is becoming a more important factor in diagnosis, therapy, and rehabilitation

The cost pressure in the healthcare system is giving rise to new technologies, new structures and new business models – above all in the affluent industrial nations with their ageing societies and often higher levels of public debt. Electromedicine is in demand in these countries as a way of helping to ease the burden on the healthcare systems. The key areas for its deployment are undoubtedly therapy and rehabilitation, but in diagnostics, too, it has a big part to play.

### Technology can help to restore lost quality of life

The efficiency of the healthcare sector can thus be boosted by technology that makes surgical interventions simpler. This increase in simplicity reduces nursing care and costs; and, last but not least, the patient can resume a self-determined lifestyle far more quickly following the operation. For example, the implantation of artificial joints is now usually a routine operation thanks to electromedicine. Such interventions restore some of the quality of life lost by patients and reduce their reliance on assistance from other people. In this regard electromedicine can thus be of equal benefit to the patient and the healthcare system.

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<sup>9</sup> Intervention means that an operation can be performed with very high precision and causing only minor side effects.



## Electromedicine driving healthcare

Units with greater capital resources  
can accelerate innovation

Like all manufacturers in a competitive sector, however, companies in the healthcare business require a politically defined framework that guarantees a reliable basis for planning and transparency as well as a minimum of advance notice and time. This enables them to plan their business activities and to invest in research and development, jobs and manufacturing resources and/or new medical technology. The investment backlog in public-sector healthcare calls for a modernisation of the remuneration systems for hospitals and doctors which will enable the long-term funding of necessary investments from revenues.

In the increasingly privatised healthcare sector, by contrast, one current trend in Germany is the growing number of mergers occurring in the health insurer and hospital segments.<sup>10</sup> This creates units with greater capital resources that can more rapidly implement the requisite projects at a higher level and with a bigger financial footprint.<sup>11</sup> This applies all the more since there is an increasing number of specialised private hospitals that are more able to stump up the investments required for modern technology.

Demand for healthcare services is  
changing

In this general situation patients and doctors are becoming increasingly conscious of their responsibility for the efficiency of the healthcare system. For example, 80% of the doctors just surveyed by consultants Bain & Company consider that cutting costs in the healthcare system is one of their responsibilities. In addition, as private consumers become more health conscious their concern for their own well-being and health is making them more willing to pay out of their own pocket for services – including prevention – that are not covered by their health insurers. Accordingly, communication and information are becoming more and more important for this informed and responsible new breed of patient. Demographics is opening up new potential on the demand side. After all, with the average age of population rising, sufficient wealth and growing health consciousness in particular there is also a directly increasing demand for health services in the affluent industrial nations.

However, electromedicine opens the door to major improvements not only in the areas of therapy and rehabilitation, but also in diagnostics. For what is really required first is modern diagnostics in order to make precise diagnoses faster and thus to devise appropriate therapeutic measures. Examples of modern electromedicine that help to ease the burden on the healthcare system via the new diagnostic tools can be found especially in modern cell and tissue technology, computer-aided diagnosis (CAD), optical biopsy and medical image processing. Examples are: endoscopic procedures with sensitive sensors and navigation systems that supply the doctor with the necessary information in close to real time.<sup>12</sup>

Pilot projects indicate potential

After all, electromedicine provides a myriad of possibilities for restructuring numerous processes in the healthcare segment. Pilot projects, such as those at the Universitätsklinikum Hamburg-Eppendorf hospital, already show that innovations like the paperless hospital or management systems for the use of sterile instruments<sup>13</sup> enable significant cost savings to be made.<sup>14</sup> Furthermore, there are signs that hospitals are making the organisational change of merging

<sup>10</sup> See Bräuninger, Dieter and Antje Stobbe (2012). Gesundheitswirtschaft: Weiteres Aufwärtspotenzial. Aktuelle Themen. Frankfurt am Main.

<sup>11</sup> Over the last ten years the number of hospitals in Germany has dwindled by more than 180. Those particularly affected were hospitals run by municipal authorities. This trend is expected to persist. Several hundred German hospitals could therefore be affected by this wave of consolidation.

<sup>12</sup> See Lenkeit, Daniel (2011). Moderne Diagnostik verspricht gezieltere Behandlung und geringere Kosten. Press release Germany Trade and Invest. Berlin.

<sup>13</sup> See Kraft, Marc (2010). Effektives Prozessmanagement mit innovativer Medizintechnik. Berlin.

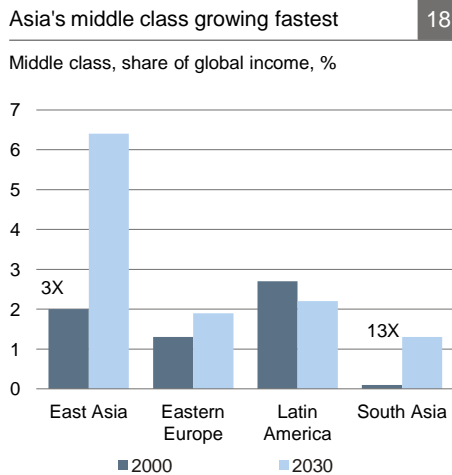
<sup>14</sup> Spectaris estimates that around EUR 100 m could be saved on sterile instruments alone in Germany. See Spectaris et al. (2010). Das Einsparpotenzial innovativer Medizintechnik im Gesundheitswesen. Berlin.



## Electromedicine driving healthcare

their IT resources. Going forward, this could result in very extensive innovative solutions such as those currently being extolled in the area of cloud computing, for example.<sup>15</sup>

### Growing demand for electromedicine from the emerging markets



Like many other sectors electromedicine has benefited from rising demand from the emerging markets over the past few years. Even though the global economy is stuttering we expect the structural growth momentum in investment and consumption to be maintained. This is backed up above all by the expanding middle class (see chart), for example in Asian countries where demand is growing for consumer durables and higher-quality services. At the same time, the infrastructure is being expanded in these countries not least in order to supply the rapidly rising urban population. The demand for electromedical products should benefit from this development in future, too.

Demand in international markets is dominated by two trends that overlap. On the one hand, the difference in income development and distribution determines demand and purchasing power. As such, high-end equipment is not always the ideal solution for providing care to broad sections of the population. On the other hand, however, the objective in emerging markets in particular while establishing modern structures is to directly exploit the benefits of today's technologies and convert them into efficient processes. Outdated structures do not have to be broken down in order to achieve this as they do not even exist in some cases. The implementation of modern processes is thus a general characteristic, while the product technology features certainly can vary from country to country and depending on the respective healthcare philosophy.

### Technology goes mobile

The opportunities for electromedicine expand further, if it appears to be quick and easy to use. This is even more the case if the applications are used in both an institutional and a private environment. Such innovations are therefore particularly promising because they are driven by the users and not by the provider firms.

One outstanding example of such new usage options that have found their way from the personal sphere – where they even provide enjoyment – into the work arena are apps for smartphones and tablet PCs. For instance, there is an ever increasing number of apps for the medical segment which are used by medical staff. For example, hospital doctors can now use this modern technology to access the digital medical records of patients in the hospital information system and thereby save themselves going through medical records by hand.

### Constraining factors also apparent

Besides the various positive aspects of the market environment there are also negative aspects. For example, two out of five companies recently surveyed in Germany by Spectaris stated that the costs arising from general legislation concerning medical products and regulatory approval for new products are holding back their market performance. In addition, just one in six firms cited problematic alliances and one in ten mentioned insufficient public funding as impediments. In this regard state subsidies for research and development can help small and medium-sized enterprises in particular.

Funding, skilled personnel and economic development are major factors

<sup>15</sup> See Heng, Stefan and Stefan Neitzel (2012). Cloud computing: Clear skies ahead. Deutsche Bank Research. E-economics. Frankfurt am Main.



The current structure of the social health insurance (SHI) scheme tends to impede dynamic development of the health sector on the basis of competition between innovative products, services and solutions. The assumption of the costs coverage for medical services is laid down in the list of authorised benefits for members of the SHI scheme. In Germany the decision about inclusion in this list of authorised benefits is made by the GBA (Gemeinsamer Bundesausschuss), a self-governing body consisting of representatives from the health insurers and hospitals and doctors. Services not on this list cannot be invoiced when provided on an outpatient basis, while the so-called Verbotsvorbehalt, which permits all treatment innovations that have not been explicitly banned, applies to inpatient services. True, the remuneration levels for existing procedures do allow the invoicing of newer methods, albeit without an innovation bonus. Nevertheless the separate billing arrangements for outpatient and inpatient services is a fundamental problem in the German system. The remuneration system does not provide incentives for integration, so the artificial divide between the two sectors persists. Innovations could in principle have a far-reaching impact on procedures across sector boundaries, but they are not taken into account in the remuneration systems and therefore tend not to be embraced.

The currently planned arrangement for trialling new medical products and procedures has the potential to speed up the production of information for cost/benefit analysis or to make it even possible in the first place. Furthermore, health insurers have the possibility of striking their own agreements with service providers on remuneration terms that exceed the level set by the authorised list of benefits (selective agreements). The increased number of mergers between health insurers to form larger organisations could result in this scope being exploited more extensively in future. Accordingly, a more innovation-friendly structure for the remuneration system with a greater freedom of choice for the insured person – also with regard to e-health, telemedicine, homecare for elderly people and the chronically ill (see Heng, Stefan (2009). Age-appropriate information technology on the advance Deutsche Bank Research. E-economics 74. December 29, 2009. Frankfurt) – and an additional cost arrangement for the authorised list of benefits could also significantly boost domestic demand for electromedicine.

Since the introduction of diagnosis-related groups (DRG list) for the remuneration of medical services in public hospitals the scope for hospitals to generate revenues per patient has been capped. The efficiency with which a hospital operates is therefore more dependent on stabilising cost structures below revenues via DRGs than was the case when the flat rate fee system still existed. To achieve this it is important to reduce expenditure both in the use of products, that is in the individual stage of the supply chain, and in the interdisciplinary processes in the everyday operation of a hospital. In a study conducted over many years the ZVEI and Spectaris associations (see Spectaris and ZVEI (2011). Einsparpotential innovativer Medizintechnik im Gesundheitswesen. Berlin) calculated that some 40 examples of innovative medical technology procedures could generate cost savings of well over EUR 4 bn in Germany.

We shall now take a closer look at the major impediments involved, namely with respect to the financing of large-scale projects (responsibility for acquisition costs and operating costs), the pool of skilled workers and the economic crisis.

#### Limited options for funding investments causing domestic investment logjam

##### Dual system is negative for innovation

Especially in Germany the legal and remuneration framework often prevents public bodies from being able to amply perform their duty to innovate in the healthcare segment. That is why investment-friendly directives are urgently required. As fleshed out below, it is particularly important to remove the obstructive division in funding for the hospital sector between the payer of the investment costs and the payer of the operating costs.

Although on the health policy side there is still no sign of sufficient stimulus, a single-system approach should be pursued in which an investment component is anchored in the fee-per-case catalogue of the DRG system. When making major investments in hospitals it may no longer be necessary to negotiate special financing terms with the health insurers in each case. If the financial



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### Closely examine reimbursement system

situation of the healthcare facilities also improves along with the legal framework, long postponed projects could be implemented more quickly.

In line with this there is currently an investment logjam in the German healthcare system which is holding back the development of the healthcare sector. The industry association ZVEI currently estimates that the investment logjam alone for medical technology in German hospitals totals EUR 15 bn. The remuneration system of the health insurers and the tight situation of the public purse make it difficult to implement major projects that make sense from a medical and business standpoint.

### Hurdles to clear to simplify the IT landscape

As stated, the innovation in products and processes will also be accompanied by a restructuring and consolidation of the IT landscapes as well. Economies of scale are to be achieved by comprehensive large-scale solutions. Fundamental challenges arise in the process, however.

### Standard interfaces help

Firstly, no single standard has become established among the medical IT networks. Merging them could require a great deal of work to programme the interfaces between the subsegments and also reduce the stability and output of the entire system. The EU has introduced the following international standards, IEC 80001-1 (“Risk Management for IT Networks incorporating Medical Devices”) and ISO/IEC 27001 (Information technology – Security techniques – Information security management systems – Requirements)<sup>16</sup>, which together specifically define the information security management system requirements for the medical IT network with respect to technical risks (especially system and data protection). The actual offerings based on these standards, still have to be designed, however.

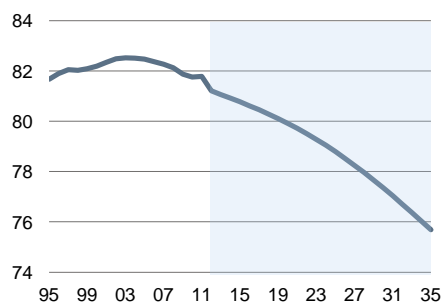
Secondly, in the process of extensive merging of the IT landscapes there is a risk that major providers will structure their systems on a proprietary basis and thereby attempt to ensure their solutions become established as the standard. Indications of such an obstructive proprietary strategy can, according to Spectaris, already be discerned with networked operating theatre systems, e.g.

Equally, in the medical technology segment, however, there is comparatively close coordination between industry and users. Developers thereby demonstrate that they can be flexible in catering for clinical demands. At the same time it represents a good opportunity for the users of innovative equipment to gain experience of and train with new technologies at an early stage. This close relationship is exemplified at both the German and international levels by the successful initiative “Integrating the Healthcare Enterprise (IHE)”, in which the interplay of different technologies in everyday clinical use is made manageable using existing standards. The IHE project in which the ZVEI participates can considerably enhance investment security and the efficiency of care processes in hospitals.

Falling overall since 2003

20

Population in Germany (million)



Assumption: Net migration of 100,000 people per year

Source: Federal Statistical Office

### The double-edged sword of demographics

21

Average life expectancy in the German population continues to rise thanks to among other improvements in medical care. As a result the number of over-65s is increasing (by 2050 there will be some 6 million more elderly people than in 2012). By contrast, the population in Germany is overall shrinking. From its current figure of roughly 82 million inhabitants Germany's population is likely to fall to 80 million by 2020 and then to 69 million by 2050 (see chart).

<sup>16</sup> The above-mentioned international standard ISO/IEC 27001 (Information technology – Security techniques – Information security management systems – Requirements) defines the requirements for dealing with IT risks for an entire company.



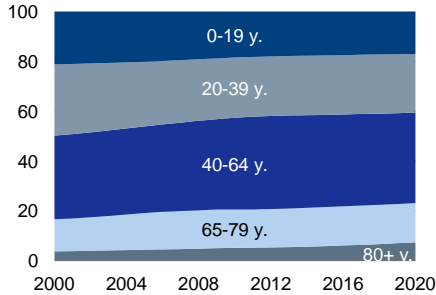
## Electromedicine driving healthcare

### Building a new structure requires skilled personnel

#### Less Under-40s

22

Total population in Germany, %\*



\*Assumption: Net migration of 100,000 people per year

Source: Federal Statistical Office, 2009

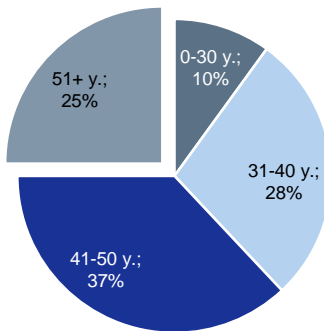
Demographic change has contrasting effects on supply and demand in the electromedicine segment. As described, on the one hand demand for electro-medical products increases in an ageing society. On the other, demographic change can weigh on the sector's development simply because in a shrinking society with a high proportion of elderly people well-trained skilled personnel will be scarce. This trend applies to electromedicine all the more, since fashioning change is particularly dependent on creative thinkers – even more so than in long-established sectors. Without these creative thinkers it takes longer for new products to be made marketable; in the worst case no innovation occurs at all.

Such a reduction in the labour supply would bring with it serious disadvantages for the sector and ultimately for Germany as a business location. This is all the more worrying given that unfavourable harbingers can already be discerned in Germany. The average age of engineers employed in the German electrical industry is 46; and this age continues to rise. So at present 62% of engineers are over the age of 40 (see chart). In addition, there are about 10,000 electrical engineers who successfully graduate every year whereas 14,000 are needed, according to the ZVEI. The shortage of skilled personnel is thus set to become much more acute by 2020.

#### Retirement wave ahead

23

Age structure of German electrical engineers, %



Status: 2009

Source: ZVEI, 2012

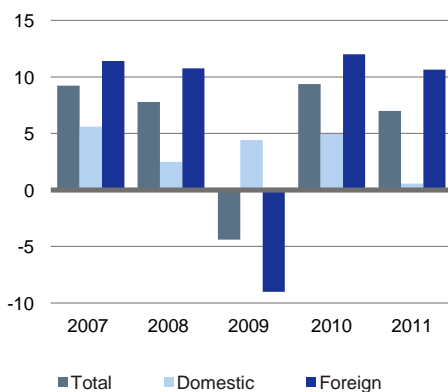
### The challenge of unpaid invoices

Over and above all these longer-term trends the ongoing financial crisis in the heavily export-oriented electromedicine segment means that small medical technology firms in particular are regularly forced to devote more attention to their clients' unpaid bills. In this connection the ZVEI points out that especially in business dealings with southern European customers even before the financial crisis it was standard for invoices to take 1.5 years to be paid, but that with the crisis the situation for suppliers has deteriorated even further. Invoices that are paid late and often only partially or even remain completely unpaid are a burden on the export-oriented sector, especially on small and medium-sized firms without major financial reserves.<sup>17</sup>

#### Domestic growth currently faltering

24

Change in German medical technology sales (% yoy)



Source: Federal Statistical Office, 2012

### Market outlook rosy

Up to and including 2030 the global health market is likely to grow by an average of 6% p.a. At the same time the per-capita expenditure on health services should rise particularly steeply in Russia (+13% p.a.), Vietnam (+13%) and China (+12%).<sup>18</sup> The Hamburgische Weltwirtschaftsinstitut (HWWI) thus forecasts that the demand for medical technology will rise until 2020 by an average of 4% p.a. in the industrial nations and an average of 16% p.a. in the emerging markets.<sup>19</sup> The global market at the start of the next decade should then probably be worth EUR 380 bn.

The outsourcing of certain activities (especially in the hardware segment) to low-wage countries is undoubtedly being considered as product lines become standardised. German companies' strong position in international trade will also continue to be threatened by foreign competition. Despite these challenges the German electromedicine business as a whole is likely to benefit from global growth.

<sup>17</sup> See VDI Nachrichten (18.11.11). Industrie prangert Investitionsstau in der Medizinbranche an.

<sup>18</sup> See Kartte, Joachim and Neumann, Karsten (2011). Weltweite Gesundheitswirtschaft: Chancen für Deutschland. Munich.

<sup>19</sup> See Bräuninger, Michael, Jana Stöver and Henning Vöpel (2010). Globale Absatzmärkte der deutschen Medizintechnik – Perspektiven und Prognosen 2020. Hamburg.



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### Germany benefits from international exchange

On this basis we expect that German electromedicine companies will continue to be able to defend their leading world market position, even as competition intensifies, by using high-quality products for establishing sustainable infrastructures and providing care to broad swathes of the population. Accordingly, we expect an annual real sales increase of 5% for medical technology 'Made in Germany' in 2012 and 2013.

### Conclusion: Electromedicine a driver in the healthcare sector

### Innovation-friendly reimbursement system required

The issue is less a matter of whether advances in medical care are feasible, but rather of the value that society attaches to these new options. After all, this must be reflected in the remuneration systems in the healthcare market. The job of policymakers is to find a solution that can be funded over the long term and which strikes a balance between delivering the medically necessary basic standard of care, on the one hand, and providing the swift access to innovative procedures for as many patients as possible, on the other hand. For the research-oriented and innovative industry the primary objective is for investments in innovations in the healthcare market to pay for themselves within a foreseeable timescale.

German medical technology companies are enjoying international success thanks to their high-quality products. This is reflected in both the strong sales of the German medical technology firms compared with those from other industrial nations and in the export share of over 70%, which is even higher than the already huge share for the electrical industry as a whole. Innovations in Germany benefit from good general conditions, especially in terms of infrastructure and the pool of skilled staff. The segment plays a pivotal role in the healthcare business, driving employment and growth.

The segment with its products and solutions for clinical challenges is a key component of modern healthcare infrastructures. Electromedical systems help to further boost quality and cut costs by not only optimising processes in hospitals. One important factor is the ever closer interlinking of medical systems and information technology. The technology thus takes into account demographic shifts and the resulting new requirements for care.

### Remuneration system under fire

Innovation is hampered by the time-consuming production of cost/benefit analyses that are required for the introduction of innovative methods. Temporary public funding of new methods could help to correct this shortcoming. Another problem is the artificial separation of remuneration systems in Germany between the outpatient segment (based on the so-called EBM) and the inpatient segment (based on DRGs). It prevents integrated treatment approaches and patient-oriented care, because it unnecessarily splits up the process into individual episodes, instead of enabling a holistic health management. What is also required is a remuneration system that will meet the demands of the new care reality over the long term.

Health policy should chip away further at the investment-hampering separation between the payer of the investment costs and the payer of the operating costs. An investment component should be anchored in the fee-per-case rules of the DRG system. Special agreements with the payers could augment this system as required. If the accounts of the healthcare facilities improve along with the legal framework, long-delayed projects could be implemented faster.

Their high-quality products should enable German electromedicine companies to maintain their leading global market position – despite growing price competition – while establishing sustainable infrastructures and delivering care to broad sections of the population. Accordingly, we expect the German electromedicine sector to post real growth of 5% yoy in both 2012 and 2013.



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This expectation is based on the assumption that both the modernisation and the setting-up of new structures in the healthcare segment will continue to gain global significance and thus that healthcare spending will rise internationally.

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