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Medical Technologies

Benchmarking Report for Germany

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1.1. Economic Overview

With over 82 million people and a GDP of over 2,110 billion Euro in 2002 Germany is still the third largest economy behind the US and Japan. However, in each of the past ten years, growth has under-performed even the very modest rates achieved in the "Euro-countries" making it obvious that Germany suffers under problems that are more structural and less cyclical.

Table 1: Basic Figures 2001: Germany, France, UK

	Population in million	GDP per capita ($)*	Disposable income per capita ($)*	Unemployment rate	Long-term unemployment (>12 months as % of total)	Export as % of GDP	Import as % of GDP
Germany	82.3	26,321	16,391	7.8	51.5	30.8	26.2
France	59.2	26,177	16,630	8.5	37.6	22.6	22.4
UK	59.8	26,369	16,667	5.0	27.7	19.2	23.1

*Current prices and current PPPs (purchasing power parities)
Source: OECD, Basic Structural Statistics, 2003

The structural problems result to some extent from the encumbrances of the reunification after 1989, however, the reunification merely boosted an evolution that would have happened nonetheless. One main reason for Germany's economic problems is its social security system which is composed of five statutory insurances (Table 2), organised as pay-as-you-go-system. It highly depends on the working people who pay the contribution rates by which the actual social benefits for the elder generation, for sick and unemployed people are financed.

Table 2: Statutory Social Insurance System in Germany in Billion Euro, 2001

Statutory Social Insurance	Expenses in billion Euro	% of total	Average contribution rate (% of gross salary)
Retirement	226	50	19,5
Health	136	30	14,0
Unemployment	65	14	6,5
Nursing Care	17	4	1,7
Accident (contribution rate paid by companies only)	11	2	
Total *	**455**	**100%**	

*The actual expenses are 419 billion Euro – the higher amount is due to insurance internal clearing.
Source: Verdi, 2003

Owing to the continuous expansion of social benefits and services social contribution rates increased over the last decades in conjunction with tax rates. Therefore, social insurance contribution rates (employees and employer parts) sum up for over 42 percent of gross income right now. This was associated with negative employment trends (Table 3) and consequently with diminishing revenues of social insurance agencies.

Table 3: Employees subject to Social Insurance Contribution in Germany, 1993=100

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
103.0	100.0	98.7	98.3	97.0	95.4	95.1	96.1	97.3	97.3

Source: Federal Employment Service

Reforms of the social system including the health sector are reminded by national and international institutions (e.g. by the EU because the current budget deficit is in excess of the 3% limit set by the EU's Growth and Stability Pact). If Germany wants to solve its problems, structural reformation processes of the social insurance system have to be enforced (see Chapter 1.6 as well).

1.2. Technology and Innovation Policy

Data on R&D

Although the economic outlook seems negative, Germany still has well-trained and motivated people, innovative companies and an excellent scientific and technical infrastructure that gives the country a leading position in technology and innovation worldwide. International comparison shows that Germany spends 2.48% of its GDP for R&D while France spends 2.15% and the UK 1.86%. Only Japan, Finland and Sweden spend about or more than 3%, the US use 2.7% but here capital expenditures are excluded (OECD 2002)[1]. In 2001, expenditures for research and development in Germany were split between public institutions, universities and the private sector by 14% : 16% : 70% (Table 4) showing clearly the strong involvement of the business enterprise sector in innovation and research. However, public support, i.e. federal programmes and joint Federal-Länder schemes including non-university institutes[2] are of enormous importance for the innovation landscape in Germany. In the last years those programmes were the driving force to push innovation in fields such as biotechnology or information technology – areas that were neglected by the private sector due to historic concentrations. Further, they support new organisational structures such as networking and increasingly stress the regional dimension of collaborations (e.g. competence centres).

Table 4: Expenditures for R&D by Sector in Million Euro; Germany

	Public institutions and private institutions without	Universities	Business enterprise sector	Total
2001	**7,146**	**8,442**	**36,350**	**51,938**
1995	6,266	7,378	27,014	40,658
1991	5,457	6,145	26,421	38,023

Source: Federal Statistical Office

[1] For more information on R&D expenditures see Bundesministerium für Bildung und Forschung: Fact & Figures Research 2002.

[2] The key players in Germany 's research landscape – such as the Max Planck Society (MPG), the Fraunhofer Society (FhG), the Centres of the Hermann von Helmholtz Association (HGF), the "Blue List"-institutions, and the Science Council (Wissenschaftsrat) – are jointly funded by the Federal Government and the Länder governments.

Table 5: People employed in R&D by Sector; Germany

	Public institutions and private institutions without	Universities	Business enterprise sector	Total
2001	**71 906**	**101 443**	**314 330**	**487 679**
1995	75 148	100 674	283 316	459 138
1991	90 711	103 864	321 756	516 331

Source: Federal Statistical Office

In 2000, the Federal Government's expenditure for research and development amounted to Euro 8.4 billion, which was 2.3 percent higher than the comparable expenditure in the previous year. The 2001 budget appropriated a total of Euro 9.0 billion for R&D, an increase of 7.1 percent over 2000.

The Federal Ministry of Education and Research (BMBF)

The BMBF plays a prominent role in innovation policy with financing nearly two-thirds of all federal R&D expenditures. The budget is 8,364 billion Euro or 3.3 percent of the entire federal budget. 38 percent of the BMBF budget are spent for promotion of technology and innovation, 21 percent for knowledge-oriented and cross-programme basic research, 14 percent for research and development to provide for the future. The Ministry's research promotion schemes contain plenty of programmes with two areas being particularly relevant for medical technology: "biotechnology/health research" and "innovation support and technology transfer". The research report of the Ministry summarizes under 'project funding' the following:

> *"One particular form of project funding is support of 'competence networks', involving use of competitive procedures to identify and support 'innovation clusters'. The members of such clusters, representing different industries, technologies and parts of the value chain, solve problems co-operatively. A first example of this approach, the BioRegio competition, has been followed by competitions for centres of excellence in nanotechnology, competence networks for medicine and centres of excellence for medical technology, and the InnoRegio regional competition, which is not tied to any specific areas. In this context, mention should also be made of the BMWi 's (now BMWA – note of author) Promotion of Innovative Networks (InnoNet) Programme, which is used to support the development of research networks comprising both small and medium-sized enterprises and research institutions." (BMBF 2002a).*

Further, under the BMBF's roof the central, self-governing national support institutions is located, the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) that promotes research at universities and other publicly financed research institutions in Germany. It serves all branches of science by funding research projects and facilitating cooperation among researchers. It disposes of funds of almost 1.3 billion Euro.

In 2000, the Federal Government passed an extensive **federal health research programme** ("Health Research for the People"[3]) that lines out the main fields of promotion in the health sector including research of diseases and prevention, structural changes in the research landscape and better collaboration of academia and private sector. It refers to medication, medical technology and communication information technology ("telematics") as important fields of research that are narrowly connected with collaborations with private enterprises. The programme structure with its four areas for action and its financial setting is under the responsibility of the Federal Ministry of Education and Research and the Ministry of Health (Table 6).

Table 6 Project Funding by the Federal Health Research Programme

Areas for Action (I.-IV.)		2000 (mill. Euro)	2001 (mill. Euro)	2002 (planned, mill. Euro)
I.	Effective Disease Control	46.1	49.2	58.5
II.	Health Care System Research	7.8	6.3	6.4
III.	**Collaborative Health Research between Private Enterprise and Science (drug therapy, medical technology, telematics)**	**18.9**	**25.4**	**22.3**
IV.	Strengthening the Research Landscape by Optimising Structures	34.1	32.1	28.8
Total		106.9	113	116

Source: Federal Ministry of Education and Research

Medical technology funding as part of the third area for action concentrates on the following:

- Technical aids for disabled people.
- Promotion of regional networks of competence (Kompetenznetzwerke, see below).
- Stimulation new fields of knowledge in medical technology.

The *networks of competence* are regional alliances that cut across scientific and technical as well as industrial sectors and include all stages of the development up to the market launch of a product. In the late 90s, the BMBF developed this programme for supporting wide-spread networks, based on the concept of technology clusters like Silicon Valley, with a focus on supporting structures rather then individual projects. It was important to support networks which include the entire value-added chain to take advantage of vertical synergy effects. This is accomplished by the networks by combining participants reaching from universities and hospitals over manufacturing and health insurance companies to trade unions and communes. The goal of the networks is to create an efficient synthesis of different regional concentrated and interregional oriented institutions, with the consistent support by politicians and chambers. Usually, the ventures focus on specific fields within the sector of their industry. Once an idea of a *network of competence* is developed, it can apply at the advisory council of the VDI (Verein Deutscher Ingenieure, an association of German engineers), which works on behalf of the BMBF, and supports the networks in public affairs, e.g. it established a

[3] Gesundheitsforschungsprogramm der Bundesregierung: „Gesundheitsforschung: Forschung für den Menschen". (Programme of the German Federal Government: Health Research: Scientific Research for the People), 2001.

communication platform for the networks of competence (www.kompetenznetze.de). The BMBF itself helps the networks by funding and professional promotion through project executing organisations, which are mostly associations of the specific technology sector. Not all of the networks included in the VDI-platform receive funding by the BMBF. The advisory council of the VDI constantly evaluates new and already established networks. A recent evaluation of the networks gave a positive feedback. In 1999, the BMBF started a competition where excellent networks in the medical technology sector could apply to get support by the BMBF and the VDI. Eight centres were selected for funding in the competition, two of them in Baden-Württemberg. The centres chosen as winners do not only have a well-organised infrastructure but also submitted convincing project proposals on advanced medical technology subjects to be realised during the start up phase. Each centre receives up to 770,000 Euro per year for building up their organisational structure and for running selected research projects over five years (i.e., 3.8 million Euro per network). In the mean time an additional network – Erlangen-Nürnberg in Bavaria – was integrated.

The winners of the 1999s competition by the BMBF are:

- Aachen: Competence Centre for Medical Technology – focused on miniaturized medical technology
- Weser-Ems Region: HörTech · Centre of Competence for Hearing Aid Technology – focused on hearing instruments
- Bochum: Ruhr-Centre of Competence for Medical Engineering – focused on Diagnostics Ultrasound
- Hannover: Medimplant – focused on therapeutical effective cardiovascular implants
- Tuebingen-Tuttlingen: Minimally Invasive Medicine & Technology (MITT)
- St. Ingbert/Berlin: Competence Centre for Miniaturized Monitoring and Intervention Systems (MOTIV)
- Thueringen: Competence Center OphthalmoInnovation Thueringen – focused on systems for diagnosis and therapy of the most common eye complaints
- Bochum/Karlsruhe: TELTRA competence center – focused on telecommunications and computing in the area of traumatology
- Erlangen/Nürnberg: Medical Technology– focused on minimally invasive diagnosis and therapies

To help new innovative ideas to gain acceptance is another task of the health technology promotion according to “area of action III”. The funding is primarily targeting the improvement of basic research in science and technology. An *innovation competition* for medical technology is taking place annually to especially support individual research ideas of a highly innovative and original character. The goal of this measure is to overcome barriers to innovation transfer and provide help in kick-starting and speeding up the process from a promising idea to a usable method or a commercially viable product. In 2002, eleven research teams won the competition, sharing 2 million Euro in prize money.

Furthermore, *innovative single actions*—where German-wide university researchers and companies take part—can be supported as well.

1.3. Innovation Policy and Regionalisation

Due to the federative organisation of Germany regional economic development was always under the responsibility of both the federal level and the single Länder (e.g. through the joint State-Länder-task "Improvement of Regional Economic Structures", one of the largest subsidy programmes in Germany which supports regional development mainly in weak areas). For some years now, federal laws and programmes are explicitly supporting regionalisation strategies, not only in the field of research and development. For instance, labour market organisation is under reformation with the goal to streamline bureaucracy and give more responsibility to the regional and local employment offices.
In terms of research and development Germany shows a strongly decentralised structure, especially compared to France and the UK where research is largely concentrated in regions around the capitals. A regionalised research structure is viewed as an advantage in the diffusion of new technologies because decentralised R&D centres help that new technology spread more rapidly over geographical areas and be taken up faster by companies. This seems to be true mostly in an early phase of the innovation cycle where the exchange of knowledge is very important and tied to personnel, personal contacts and close relationships to university and research institutes. [4]

The main promotional approaches of the German Government to stimulate regional competences in pioneering areas of technology are (Table 7):

Table 7: Most Important Federal Programmes for Regional Development

Programme	Description
Joint State/Länder-Task "Improvement of Regional Economic Structures"	Biggest investment promotion measure in Germany (founded 1969) which covers the structurally weak regions and which now supports a growing number of innovation projects such as technology centres to attract new businesses, projects to train human capital and R&D projects by SMEs. Between 1995 and 2001 about 900 million Euro in promotion flowed to innovative projects.
Competence Networks	Promotion of regional networks in new technology fields including innovation chains from basic research to application, with complementary measures, like training skilled personnel.
InnoRegio	Support of 23 regions in the new Länder to help to implement their innovation concepts (255 million Euro until 2006).
InnoNet	A competition since 1999 where at least 2 research institutes and at least 4 SMEs can receive funding. No focus of a technology or branch.
BioProfile	A competition to sharpen regional profiling by coordinating biotechnology research and

[4] For further information see Fraunhofer Institut für Systemtechnik (2000).

	the transfer of research results into applications (50 million Euro over five years).
Innovative Regional Growth Cores	A new programme that supports collaborative projects with a high market potential. So far nine growth cores have been awarded about 40 million Euro for a period of three years. More projects will be included.
Interregional Alliances for the Markets of Tomorrow	Forums in the new Länder where "early stage" innovative initiatives are assessed.

Source: Ministry of Economics and Labour, 2002

Due to own tax revenues the single Länder can implement their own industry policies. How Bavaria and Baden-Württemberg are taking advantage of this in terms of medical technology support programmes and innovation polices will be described in Chapter 3.

1.4. Industrial Relation System

As mentioned above the German labour market is highly regulated by law and collective agreements. The German industrial relations system delegates a great deal of authority to the social partners to reach binding agreements. The Federal Union of German Employers' Associations (Bundesvereinigung der Deutschen Arbeitgeberverbände) has two levels of associations, industry associations and state associations. Most companies belong to one or more industry associations and possibly also a state association. The employers' associations do not correspond exactly to the number of unions, and frequently several employer organisations negotiate with one union. Under certain conditions, employers may also bargain individually with unions.

On the unions side, the most important confederation of trade unions is the DGB (Deutscher Gewerkschaftsbund) with 7.7 million members. Now there are 8 industry trade unions affiliated to the DGB including the world's largest service sector union ver.di that arose from five white collar unions in 2001 (e.g., public service union, retail trade and banking sector union, media union) representing more than 2.7 million members. Another 1.1 million public officials are organised in the German Civil Service Federation (Deutscher Beamtenbund). Finally, a small number of workers (0.3 million) is organised in unions under the Christian Trade Union Confederation. While collective bargaining of wages and working conditions takes place on a regional level it is not much of a surprise that the bargaining system is nevertheless highly centralised.

At the plant level, the works councils play a crucial role in regulating working conditions and training. Works councils are elected bodies with information, consultation and participation rights at the plant and company level. Employees in plants with at least five regular employees are entitled to elect representatives to a works council. However, small enterprises often don't have a works council. Works councils have the right to negotiate with management about a wide range of topics like the scheduling of the working day, incentive pay, job design, the development of guidelines for hiring, layoffs, and reclassification, the training plan, and social plans. Additionally, they have information and consultation rights about health and safety measures, personnel planning and general company planning. The

rights of works councils is governed by law (Betriebsverfassungsgesetz). Recently , an amendment of the law, easing the election procedures of works councils and especially reinforcing their power in SMEs was passed. A further element of the German industrial relations system consists in co-determination which applies to companies with at least 500 employees and gives the workers the right of representation on the supervisory board.

1.5. The National Educational and Training System

1.5.1. The Dual Training System

Initial dual training in Germany is regulated by the Federal Government, the social partners and industrial organisations. The German system of initial vocational training can be characterised as a „dual system“, balancing theoretical and practical training between public vocational schools and private companies. Training is carried out at the workplace (usually three days a week) and in the school. It is a corporate tripartite system, with the government, the employers' organisations and trade unions being included in the process of regulation, financing, administration and controlling of training in the dual system. Trainees are trained in one of the 360 State-recognised occupations requiring formal training.

The aim of the dual system is to provide a broadly-based vocational education and the necessary skills and knowledge required to practise an occupation in a properly structured course of training. The general structure of the training consists of a first year offering a wide-range basic training course, a second year with increasing specialisation and a third year ending with the examination for a skilled worker (Facharbeiter).

The Federal Ministry for Education and Research is responsible for the vocational training policy. It is supported by the scientific advice of the Federal Institute for Vocational Training (Bundesinstitut für Berufsbildung BIBB). The board of the Federal Institute is composed of employers, workers, the Länder and the Federal Government. The members of the board follow the principle of consensus. The aim of its research, development and counselling activities are to identify the future functions of vocational training, to promote innovation in vocational training and to develop new and practically viable solutions for use in initial and continuing training. A pivotal task of the Institute is to prepare the curricula of training. The procedure of drawing up or changing training regulations for the State-recognised occupations involves the participation of the employers' associations, the trade unions the relevant Ministries and the Federal Institute for Vocational Training. Furthermore, there is a proper procedure for drawing on the experience from occupational research and the results of pilot projects and tests carried out by the Federal Institute for Vocational Training. Employers provide dual training in recognised occupations listed by the Federal Institute. Since adherence to the training regulations is obligatory, a uniform national standard is guaranteed.

The skills and knowledge which are to be trained at the workplace are fixed in a framework plan (Rahmenplan) for the trade or occupation. The training company incorporates this into its own individual training plan. The occupational subjects to be taught at the vocational school (Berufsschule) are stipulated for each trade or occupation in a framework curriculum. The Länder – who are controlling the

school-based portion of the dual system – either adopt the framework curriculum as it is or convert its provisions into their own curricula. Initial training at the workplace is governed primarily by law (Berufsbildungsgesetz) and the relevant regulations of the Chamber of Trades (Handwerksordnung). Training is provided on the basis of a civil-law contract between the business providing training and the young person concerned.

The chambers play an important role in the preparation, administration and control of on-the-job portion of the dual training system. They award training licences, control the delivery of on-the-job training, release examination regulations, organise the examination of apprentices, and offer continuing training courses for instructors. Following the Vocational Training Act of 1969 the chambers set up a vocational training committee composed of representatives of employers, employees and teachers. Their main function is the organisation of apprenticeship examinations. Successful examination candidates are awarded a certificate showing proficiency as a skilled worker (Facharbeiterbrief), commercial assistance (Kaufmannsgehilfenbrief) or journeyman (Gesellenbrief).

The companies engaged in dual training have to acquire eligibility to provide training. This can be achieved through a trainer examination to be passed at the Chambers of Commerce or the Chambers of Trades. The majority of approvals is acquired by the masters' exams in different trades. In 1998 there were 780,000 approved trainers in the dual system. The relation between apprentices and trainers was 2:1 on average.

There is no obligation for the employer to hire the apprentice after he or she has finished his or her apprenticeship. In 1998, 58 percent of young people having finished their apprenticeship were employed by the same company where they were trained.[5]

Small enterprises play a crucial role in the „dual system" of vocational training. In 1998, one fifth of the apprentices were trained in companies employing 1 to 9 persons and another 32 percent in companies with 10-49 employees. This represents a higher proportion of trainees in relation to the employees in small companies than in medium sized and large companies.[6]

As the following table shows, the dual training is largely financed by companies:

[5] Federal Ministry for Education and Research: Berufsbildungsbericht 2000 (Occupational Training Report).
[6] Federal Ministry for Education and Research: Berufsbildungsbericht 2000.

Table 8: Financing of the Dual Training System

	Billion Euro 2001
Enterprises	
Gross expenditure	21.7
Net expenditure	*12.9*
(minus output value of apprenticeship work)	
Federal and Länder Governments	
Vocational schools	3.2
Specific training programs	0.4
Federal Employment Service	3.7
Total	20.2

Source: Berufsbildungsbericht 2002.

The companies pay trainees a wage, which is subject to a contractual collective bargaining agreement. In 2001, the average apprenticeship wage amounted to Euro 582 per month in western Germany. In total, companies spent about 21.7 billion Euro in 2001 for training in the „dual system". Training at the school (Berufsschule) was financed by public funds with 3.2 billion Euro. Additional public funds were available to support the training of disabled or socially disadvantaged young people, and the training of foreigners.

If firms are not able to provide training under the set training regulation they can still be involved in the training scheme thanks to the provision of complementary training measures at supra-company training centres (ueberbetriebliche Berufsbildungsstätten). Due to the restructuring problems facing industry in the new *Länder*, young people there, who are unable to find a training place in a company, can receive initial vocational training at a publicly funded non-company training centre (außerbetriebliche Berufsbildungsstätte). The practical aspects of training programmes normally covered in a company are carried out in training workshops and learning offices set up by the bodies responsible for training.

For some occupations, vocational training is done at full-time vocational schools (Training Colleges · Berufsfachschule). There are full-time vocational schools, among others, for business occupations, occupations specialised in foreign languages, crafts industry occupations, social-work-related occupations, health sector occupations, artistic occupations. In cases where such schools do not provide a full career qualification, the period of attendance may – under certain conditions – be recognised as equivalent to the first year of vocational training in the dual system. The duration of education at those schools varies, but it takes at least one school year and normally leads to a final examination.

1.5.2. Continuing and Professional Training

In contrast to initial vocational training, further and continuing vocational training is fairly unregulated. This type of training is mostly organized by companies, but other institutions, such as the Chambers of Industry and Commerce, the Chambers of Trades and training centres of the unions, are also involved. Note, that further training in order to become a master craftsman or foreman (Meister) is regulated like state-recognised occupations. At the enterprise level works councils have participation rights in respect to continuing training.

About 14 percent of the labour force carries a university degree (Universität and Fachhochschule)[7]. In 2002, about 1.9 million students were enrolled in higher education. Business administration ranged at the first place of the courses studied. Biology and chemistry and medicine figured among the top ten together with several engineering courses. From 2001 to 2002 the number of new entrants in the first semester of engineering grew by 7%.[8]

1.5.3. Strengths and Weaknesses

A major problem of the German vocational training system consists in a mismatch between actually trained and required qualifications as well as in a mismatch between the supply and the demand of training places. The training rate has been declining during the 1990s. In 1998, the training rate, defined as the relation of trainees to employees, was considerably lower in most industries than in 1990. Therefore, in 1998 the employers and unions agreed an employment pact which is not only tackling the problem of high unemployment rates in Germany but also the problems related to vocational training (Buendnis fuer Arbeit, Ausbildung und Wettbewerbsfähigkeit). Since then, the balance between supply and demand for training has improved and steps towards a modernisation and more flexibility of the dual system of vocational training were implemented. Furthermore, the federal state and the social partners are elaborating new concepts and strategies for ensuring a transparent and flexible system of continuing and further training. On a regular basis, the partners involved are also debating training issues on a regional level.

Despite the fact, that the German dual system of vocational training is hold up as a model, the dual system has been questioned.[9] Criticised are especially the quality of vocational training, the mismatch between the training which was done, and the skills which were necessary for the economy and the slow adaptation to new technologies. The slow adaptation to demographic, social, technological and economic changes was marked to be one factor explaining Germany's slow growth and deferred transition into the services economy. Thus, the Ministry for Education, Science and Technology is enhancing the flexibility by speeding up the adaptation of training regulations. This process used to take many years as a consensus agreement between the social partners was required for any change. Between 1996 and 1999, however, the regulation of about 90 occupations were revised.[10] In order to enhance the flexibility of the vocational training system the modularisation or unitisation has been being discussed since the mid-1990s. In the recent past, the first initial traineeship programme with a modular format has been introduced.[11] Thus, a series of pilot projects on „add-on" qualifications is being implemented and the certification of qualification units is being elaborated. The underlying aim is a more flexible access to qualifications at the level of skilled workers and an interlink between initial and continuing training vocational training by means of „add-on" qualifications. All the involved parties – the social partners and

[7] Federal Statistical Office: Statistisches Jahrbuch 1998.
[8] Federal Statistical Office: 2003.
[9] Blau et al., 1997
[10] Federal Ministry for Education and Research: Berufsbildungsbericht 2000.
[11] Reuling, 2000.

the government – share the view that formal qualifications can only make for transparency if they are subject to requirements applicable nationwide[12].

Nevertheless, the discussion of the neuralgic points of the dual training has not stopped. A focal point is still the partial mismatch of professions being trained and the employment structure: In 1998, 27 percent of apprentices became unemployed, after finishing their apprenticeship.[13] Questions have also been raised as to the appropriateness of training for rigidly defined occupations in an era of rapid technological change. Acquired skills are highly specific to the training of a particular occupation, this can represent a weakness in the future as the necessity of broader qualification profiles and „lifelong learning" are discussed. In principle, the same is valid for university courses as they prepare for specific occupations.

Intense research activities on a better match of qualifications with labour market demands are under way, however, the studies' results are only rarely implemented due to the above described system of industrial relations. One institution for the analysis of qualification need is "FreQueNz", a research network of eight research institutes that aims at identifying qualification needs, developing options for action, and providing results of the research projects involved (www.frenquenz.net). The projects of the partner institutes participating in the research network cover a large variety of research fields ranging from direct observation of changes at the workplace to an international comparison of early recognition activities in competitor countries. The network is supported by the Federal Ministry of Education and Research.

1.6. Organisation of the Health Care System

1.6.1. General Remarks

In Germany approximately 2.1 million people are working in a medical occupation. Taking into account all people working indirectly for the health care system, the total rises to 4 million (i.e., 11.1% of all people engaged in economic activity) making it one of Germany's most important fields of employment. The sector's annual turnover is about 218 billion Euros and accounts for 11 percent of the country's gross domestic product[14] (see Annex 1 for a time series of Germany's GDP and health data).

The cornerstone of German social legislation including the health sector is the Social Code Book that regulates all questions related to the statutory social insurance schemes. The Social Code Book V (Sozialgesetzbuch V) contains the legal

[12] Büchtemann, Vogler-Ludwig, 1997
[13] Federal Ministry for Education and Research: Berufsbildungsbericht 2000.
[14] „Health expenditures" contain payments of the statutory health, retirement, long-term care and accident insurance, private health insurances, employers, public and private households. Expenditures are for treatment in kind, personnel and materials costs of the social insurances, investments and investment subsidies (medical research in companies is not included). Beyond the 218 billion Euro another 64,8 billion Euro so-called „income-benefits" were spent health related in 2000. Income benefits are sick-pays (Krankengeld), continued salary payments in case of sickness or motherhood (Entgeltfortzahlung), or early retirement payments in case of occupational disability. The statistics were split in 1998.

framework for the German statutory health insurance (Gesetzliche Krankenversicherung, GKV), of its organization, its way of working, its services and benefits. The following types of benefits are currently legally included in the benefit package, usually in generic terms:

- prevention of disease,
- screening for disease,
- treatment of disease (ambulatory medical care, dental care, drugs, non-physician care, medical devices, inpatient/hospital care, nursing care at home, and certain areas of rehabilitative care),
- transportation.

Almost 90 percent of the German population or 73 million people are insured with a statutory health insurance funds (SHI)[15] due to an obligatory membership up to a monthly gross pay of 3,450 Euro. People earning above this amount can decide to stay in the SHI or insure themselves in a private health insurance (7.3 million people). In 2001, the SHI alone spent about 138.7 billon Euros annually (130.6 billion Euro for health care measures, 8.2 billion for administration and others) – that is about 61 percent of the entire health care sector turnover.

In the SHI all members are entitled to the same level of benefits while contributions are a certain percentage of salary (principle of solidarity). Aside from funds which specialise in insuring miners, seafarers or farmers, most funds can be chosen regardless of profession or where one lives. At present, depending on the health fund, the compulsory contribution rate is about 14.5 percent (estimation for 2003) of gross salary which is split 50-50 between employee and employer.

A very specific facet of the German health care system is that decision making powers are delegated to nongovernmental corporatist bodies, i.e. certain rights of the federal state as defined by law are handed over to corporatist self-governed institutions. The corporatist institutions have mandatory membership and the right to raise their own financial resources under the auspices of, and regulation by the state. Further, they have the right and obligation to negotiate and sign contracts with other corporatist institutions and to finance or deliver services to their members. For the statutory health insurance scheme, corporatism is represented by the (statutory health insurance-contracted) physicians' and dentists' legal associations on the provider side and the health funds and their associations on the purchasers' side. While the framework for the SHI system and co-payment levels are set by law at the national level, most decisions on the actual contents of the uniform benefits catalogue and the delivery of curative health services are made through joint negotiations between the associations of the physicians and the SHI both at regional and national levels. Reforms including cuts would therefore require the (unlikely) support of both the health funds and the providers[16].

To lower the increasing health care expenditures (from 1992 to 2000, the health care costs raised by almost 34 percent by current prices) and to relieve employers

[15] The number of SHIs decreased from over 1,200 after the unification in 1990 to 356 in 2002 due to strong concentration processes. 287 of the 356 SHIs are company-based health funds, most of which opened up to the public in recent years.
[16] European Observatory on Health Care Systems, 2000.

from high workforce-related costs numerous reforms in the last decade sought to make health care delivery affordable and more cost-effective:

1989 Health Care Reform Act (Gesundheitsreformgesetz)
1993 Health Care Structure Act (Gesundheitsstrukturgesetz)
1997 SHI Contribution Exoneration Act (Beitragsentlastungsgesetz)
1997 First and Second SHI Restructuring Act (GKV-Neuordnungsgesetze)
1999 Act to Strengthen Solidarity in SHI (Solidaritätsstärkungsgesetz) – cancelling most of the Restructuring Act regulations by the new elected federal Government
2000 Reform Act of SHI 2000 (GKV-Gesundheitsreform 2000)
2002 New hospital compensation system: Diagnosis Related Groups (DRG)
2003 Contribution Rate Protection Act (Beitragssatzsicherungsgesetz)

Over the years various tools were introduced with the most important ones being:

- budgets for sectors or individual providers,
- reference-price setting for pharmaceuticals,
- restrictions on high cost technology equipment and number of ambulatory care physicians per geographic planning region,
- increased co-payments (both in terms of level and number of services).

The reforms were always introduced when the health care expenditures showed a steeper rise and they were able to lower the expenditures for one or two years. Then apparently the stakeholders found a way to avoid some of the measures and expenditures began to grow again. In contrast to the public say of a "cost explosion" in the health care sector, the measures were indeed able to stabilise the expenditures at least in parts, as the health expenditures as share of the GDP and the contribution rate for employers and employees in the last decade show (Table 9).

Table 9: Health Expenditure Shares, Contribution Rates and Balance of the SHI, 1992 to 2002

Year	Health Expenditures in share of GDP	Average Contribution Rate of Gross Salary to SHI	Balance of SHI in Million Euro
1992	10.1	12.71	-4,783
1993	10.2	13.22	5,323
1994	10.4	13.17	1,402
1995	10.8	13.15	-3,659
1996	11.1	13.48	-3,552
1997	10.9	13.58	861
1998	10.8	13.62	277
1999	10.8	13.60	284
2000	10.7	13.57	-15
2001	10.9	13.54	-3,034
2002 (est.)	11.0	14.00	-2,960

Source: Federal Ministry of Health and Social Security

However, the future financing of the system without rationing, quality cutting or much higher patients' co-payments seems almost impossible due to well-known factors:

a) Expenditures for health care rise because

- rate of the elder population increases with higher health costs,
- technical progress makes diagnosis and therapy more expensive,
- labour intense sector leads to high labour force costs,
- well informed patients demand for excellent treatment,
- multiple incentives for health care providers and patients to extend health care services (moral hazard).

b) Lower revenues for SHI due to

- more retirees,
- high unemployment,
- low growth of salaries,
- increasing rates of employment not subject to social insurance contribution (precarious and marginal employment, freelancing, self-employment, illegal employment),
- well earning (and mainly healthier) employees choosing private insurance.[17]

Despite these factors the German health system still has a great degree of (expensive) freedom. Patients are entitled to choose freely general practitioners or specialist or hospital care – even changing doctors during the therapy. Physicians' right of "therapeutic freedom" let to an underdeveloped use of evidenced-based medicine and hinders standardised practises. A strict data security legislation makes it almost impossible for health funds to implement cost-controlling instruments, such as disease management programmes for the chronically ill. Patients' co-payments for drugs, hospital stay, and non-physician care were raised sensibly over the last years but are limited by a range of social exceptions.

> *"The German system puts more emphasis on free access, high numbers of providers and technological equipment than on cost effectiveness or cost-containment per se (in spite of all the cost-containment acts which have been passed)." (European Observatory on Health Care Systems, 2000)*

1.6.2. Update on Current German Health Reform

In May 2003 the German Government published its "Draft on the modernisation of the health sector" (Gesetz zur Modernisierung des Gesundheitswesens). Because the conservative opposition controls the majority in the Bundesrat upper house of parliament, the Government is forced to hold consensus talks with all parties to seek for compromises.

The actual compromise paper (that has not yet an official draft's status) contains of the following main points:

- dental prosthesis will not be part of the SHI as from 2005 and has to be insured by patients by an obligatory insurance,
- sick-pay (Krankengeld) will not be part of the SHI as from 2006 and has likely to be insured by patients by an obligatory insurance,
- new co-payments for ambulatory care and higher co-payments for pharmaceuticals and hospital care,
- strengthening of patients' rights,

[17] Sachverständigen Rat zur Konzertierten Aktion im Gesundheitswesen (Advisory Council for the Concerted Action in Health Care): Gutachten (Annual Report) 2003.

- establishing of a foundation and of an institute for quality and efficiency in the medical sector,
- obligatory training for physicians,
- general practitioners as "gate keepers" (voluntarily),
- non SHI reimbursement for OTC drugs,
- reference (fixed) prices for pharmaceuticals even with patent protection,
- pharmaceutical industry has to give a 16% rebate (instead of 6%) in 2004 of those drugs that prices are not yet part of the fix price system to SHI totalling 1 billion Euro.

Expected effects:
Patients have to count on higher co-payments while employer will be relieved in small parts from high non-wage labour costs (it is estimated that SHI contribution rate will decline down to 13.6% in 2004 and 12.15% in 2006). According to SHI calculations patients will contribute to the savings by eight billion Euro in 2004 as only one billion Euro will come from the drug sector and no contribution will be made by other sectors. Hospitals are only little affected (e.g., opening hospitals in certain diagnosis for physicians in offices to overcome the separation between the inpatient and outpatient system).
Pharmacies – a strictly regulated sector in Germany- were able to stop some of the announced proposals such as a wide usage of "Internet pharmacies" or allowance of pharmacies chains.
The pharmaceutical industry is affected by the high obligatory rebate of one billion Euro in 2004, however, it seems that the "positive list" will not be introduced, a project that was declared by all health ministers in the last decade. The expansion of the reference price system will lower the pharmaceutical price level in Germany (which is regardless one of the highest compared to other industrialised countries). The inclusion of patent-protected drugs (a point that is not decided yet) in the reference price system is without question a negative signal for the research-intense pharmaceutical industry in Germany and may lead to a further relocation of research sites outside of Germany. After all, the drug sector - pharmaceutical companies and pharmacies - will be burdened with approximately three billion Euro. The medical technology industry is not affected directly, only the sector of medical aids (Hilfsmittel) is mentioned in the reform draft but without deeper cuttings.

The official negotiations will begin in September 2003 and it seems to be likely that the Act will be passed soon. Announced structural changes will not be part of the reform such as a reformation of the corporatist system (e.g., deprivation of doctors' associations) or obligatory SHI mergers. Because the actual reform does not really cut into the structures of the German health system, independent experts and even politicians urge already that a far-reaching reformation process should be initiated when this Act is passed.

1.6.3. Licensing and Reimbursement of Medical Technology in the Health Care System

The regulation of health technologies in terms of licensing, coverage and steering of diffusion and use of technologies is quite complex and inconsistent in the two health care sectors; in general, the ambulatory sector is much more regulated than the hospital sector (Table 10).

Licensing, as a prerequisite for providing services to be reimbursed by the SHI, applies to pharmaceuticals and medical devices. Medical products and devices are defined as instruments, appliances, materials and other products, which do not produce their main effect in a pharmacological, immunological or metabolic way. Since 1995 all medical devices must conform to the essential requirements of the Medical Device Act (Medizinproduktegesetz) that is coherent with EU directives. The licensing itself is the responsibility of authorized institutions (notified bodies). The question of safety and of technical suitability for the planned operational purpose of a device is the primary criterion for the market admission. It is the manufacturers' duty to demonstrate that the device conforms to all relevant requirements such as quality and efficiency.

Reimbursement decisions on medical devices depend on their use. If they are used directly by patients they are called "medical aids" (Hilfsmittel) and the reimbursement decisions are made explicitly through the federal SHIs' association. It publishes an alphabetical catalogue of all medical aids and a listing with those that are reimbursed by the SHI (positive list). Medical aids with small or disputed therapeutic benefit or low selling prices (e.g., ear flaps) are excluded. In 2000, the SHI spent about 5 billion Euro on medical aids, private households spent another 4.8 billion Euro.

Table 10: Regulation of Drugs and Medical Devices in Germany

	Drugs	Medical Devices used by Patient (Medical Aids)	Medical Devices used in Ambulant Care	Medical Devices used in Hospital Care
Licensing	Federal Institute for Pharmaceutical and Medical Devices (BfArM)	Supervising authority: BfArM Medical Device Act according to EU directives; certification through accredited inspection authorities (notified bodies).		
Decision on Reimbursement through SHI	Automatically, except negative list	According to positive list of medical aids	Federal Committee of Physicians and SHI and its Working Committee on Medical Treatment (Uniform Value Scale determines physicians' fee)	Starting 2003: Diagnosis Related Groups (DRGs); Committee of Hospitals (utilisation of medical devices is parts of the lump sum)
Implementation/ Control of Technology's Use	· Drug guidelines by the Federal Committee of Physicians and SHI, · drug budgets, · reference price system	Guidelines on remedies and therapeutic appliances by the Federal Committee of Physicians and SHI (Richtlinien zu Heil- und Hilfsmitteln)	Guidelines on remedies and therapeutic appliances by the Federal Committee of Physicians and SHI (Richtlinien zu Heil- und Hilfsmitteln)	Hospital planning by states, Federal Committee of Physicians and SHI

Source: Wörz, et al., Economix.

The regulation of medical devices and technologies in the **ambulatory care sector** is combined with the reimbursement of the physician's services. In the fee distribution system of the ambulant sector (Uniform Value Scale [Einheitlicher Bewertungsmaßstab]) each single service including medical devices and technology is valued in points. The scale lists all services which can be provided by physicians for remuneration within the SHI system. Total payment for all SHI-affiliated physicians' is negotiated by the corporatist bodies of the physicians and the SHI. To split the sum according to the scale to each single doctor is the task of the physicians' association. For expensive equipment that is not listed in the scale regional physicians' associations have their own rules if and how the physician can charge for these services. The reimbursement is further subject to control mechanisms to

prevent over-utilization or false claims, so physicians may be subject to utilization reviews at random or if their levels of service provision are higher than those of comparable colleagues.

The Working Committee on Medical Treatment (Arbeitsausschuss Ärztliche Behandlung) (a sub-division of the Federal Committee of Physicians and SHI) prioritises new medical technologies for evaluation and existing technologies for re-evaluation. Then medical associations and possibly individual experts are invited to submit evidence concerning benefit, medical necessity and efficiency of the technology. After having examined the quality of evidence presented by the applicant, the medical associations and individual experts and literature searches, the Committee can decide a) to include the medical technology in the benefit catalogue, b) to exclude it from the SHI system, or c) to exclude it from the benefit catalogue but leave the decision to reimburse it to individual sickness funds. Then another committee (Valuation Committee) sets the relative value of the treatment procedure or technology in the Uniform Value Scale.

Explicit coverage decisions are currently non-existent for the **hospital sector**. This is due to the fact that coverage of medical devices and expensive medical equipment falls under budget negotiations at hospital level and hospital plans at state level[18]. Until now, the introduction of new procedures and technologies has usually been managed by individual hospitals in the context of budget negotiations. The new Committee for Hospital Care is expected to develop health technology assessments for the hospital sector indirectly supported by the new payment system starting in 2003 (payment by DRG - Diagnosis Related Groups).

The future direction, as laid out in the Reform Act of SHI 2000, is both to extend existing health technology assessment mechanisms to other sectors, especially the hospital sector, and also to ensure that assessments and coverage decisions are coordinated between sectors. In addition, the new treatment guidelines are an attempt to steer the appropriate use of technologies.

Expensive Medical Devices (Medizinsch-Technische Großgeräte)

The following devices are classified in most states as expensive medical equipment ("big ticket technologies"):

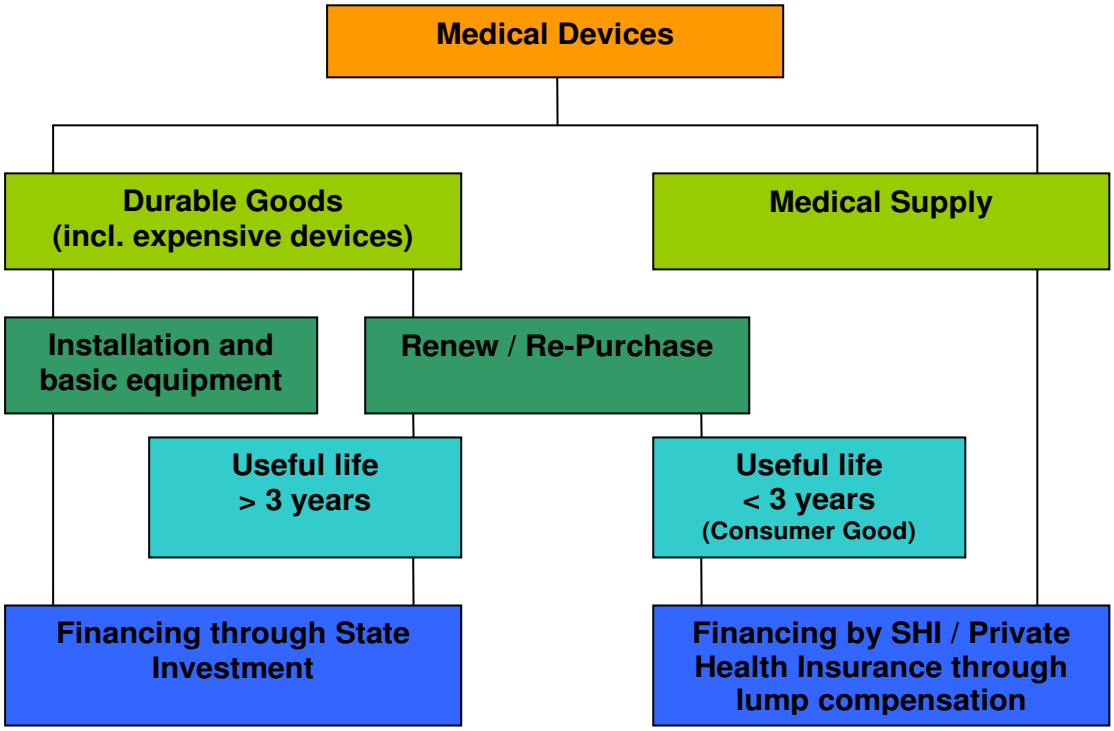
- left heart catheterization units
- computer-tomographs
- magnetic resonance imaging devices
- positron-emission tomographs
- linear accelerators
- tele-cobalt-devices
- high-voltage therapy devices
- lithotripters.

[18] The range of services provided in the hospital sector is determined through the hospital plan of the state government, and the negotiations between the health funds and each individual hospital (a result of the fact that the hospitals do not have a collective corporatist body). While the decision of the state government determines the flow of capital for investments, the negotiations determine whether the costs for running these services (incl. the use of medical equipment) are reimbursed by the health funds.

They are characterised by high investment and consequential high costs, by competitive interests between hospitals and a complicated joint usage by hospitals and ambulatory practices.

Federal laws tried to limit the acquisition of expensive medical equipment in the last decades without being successful. Since 1997 (when the joint planning process of expensive medical devices conducted by ambulatory, hospital and state representatives was abolished by law) the self-governing corporate bodies have to guarantee the efficient use (i.e., joint utilisation of equipment by the ambulatory and hospital sector) of expensive equipment via remuneration regulations.
As far as hospitals apply for single support for investments ("Einzelförderung von Investitionen"), the state Ministries remain responsible for the supply with expensive medical devices in hospitals.

Figure 1: Financing Medical Devices in the Hospital Sector



Source: Neubauer et.al. (2000)

For the manufacturers of health technology products the current reimbursement regulations are unsatisfying. They complain about the lack of willingness from the SHI to invest in high standard and innovative products. Instead of supporting the high-value and innovative branch (one of the leading export sectors in Germany), medical technology is often disqualified as "machine medicine" by the SHI that enhances health care costs without proving its positive output in terms of quality and patients satisfaction.

The Federal Government is more and more sensitive for SHI's complaints about expensive or "cost accelerating" medical technology. On the other hand, it is committed to patients' rights and quality assessment. The Government addresses the conflict in the following statement:

"An increased consideration of health care economics has to be included in the development of new technological applications. The expected or demonstrable medical added value will have to justify costs arising from its use within the health care system, or the medical technology innovations will have to be more cost-effective than existing comparable methods." (Health Research Programme of the Federal Government 2001).

2. The Medical Technologies Sector

Problems of Sector Definition

It is not possible to receive valid data on the medical technology sector in Germany. Neither the SHI nor the Federal Health Monitoring System (Gesundheitsberichterstattung des Bundes) which is a part of the Federal Statistical Office have exact data on the expenditures for medical devices, equipment or technology due to the complicated reimbursement system in the ambulatory and hospital sector. The medical technology industry itself does not provide reliable statistical data, neither on market size nor on the industry structure. This is surprising considering the importance of the medical device and technology industry in Germany. Seemingly, companies are not willing to publish company-relevant data. Another reason is that the medical technology branch is not represented by one association or interest group but by four, which show a different focus depending on market segment:

- German Medical Technology Association (represents about 200 members),
- Association of the Diagnostics Industry (78 members, focus on laboratory and home diagnostics),
- Association of Electro-Medical Engineering (about 100 members, focus on electric/electronic investment goods),
- German Industrial Association for Optical, Medical and Mechatronical Technologies (called "Spectaris", about 400 members but not all involved in medical technology).

The German Medical Technology Association acts mainly for those companies that produce consumer/patient goods (medical aids) and equipment (bandages, wound healing products, medical disposals, etc.). The Association of Electro-Medical Engineering and Spectaris founded a joint forum called "Forum Deutsche Medizintechnik" that represents most of the medical technology manufacturers and most of the sales done by investment goods.

In 1996, according to the Federal Ministry of Education and Research the share of sales in different medical device sectors in Germany was the following (Table 11):

Table 11: Shares of Sales of Various Medical Devices in Germany, 1996

Medical devices	21%
Medical technology products	20%
Diagnostics	13%
Electrical medical engineering devices	12%
Dental products	12%
Ophthalmic optics	9%
Optics, lasers, laboratory	8%
Others	5%

Source: Health Research Programme of the German Federal Government 2001, p. 38.

Medical technology products and electrical medical engineering devices account for about one-third of total sales. The most vigorous increase in turnover in recent

years has been achieved by the ophthalmic, laser, laboratory engineering and medical devices sector.

However, for consistency reasons – at least as far as data are concerned – this chapter uses data from the **Federal Statistical Office** that follows **International Standard Industrial Classification**, code 331: *Manufacture of medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes, except optical instruments*. Only firms with 20 or more employees are included.

Market

Behind the United States and Japan, Germany is the third largest market for medical devices and medical technology equipment (72 respectively 25 respectively 16.5 billion Euro in 2001 according to the German Medical Technology Association[19]). In Germany the hospital sector is the most important market place. It is assumed that in the year 2000 medical devices and technologies accounted for about 6.5 billion Euro in the hospital sector. Another 5 to 5.5 billion Euro are spent for medical devices in the ambulatory sector. In the data of the association medical devices for consumption are included.

The Federal Statistical Office summarizes medical technology as "production of medical equipment and orthopaedic devices" (see above). While the cluster contains dental products and devices, most of the "consumer goods" are not included. As in the last two years turnover was growing by 6.5% in 2001 and 12.7% in 2002, the number of firms decreased by 12% in the last five years (Table 12).

According to the data of the Federal Statistical Office 82,200 people were employed in the German medical technology sector in 2001. The latest data for 2002 indicate a further growth in employment by 2.8 percent up to 84,500 people (and that is clearly opposed to the German employment trend). The branch associations even mention about 100,000 people being employed (these differences are again a problem of insufficient data material). In 2002, the employment of blue collar workers grew more than the white collar employment for the first time. The share of white collar workers is approximately 40 percent and above the average in the manufacturing industry with 35 percent.

[19] Bundesverband Medizintechnologie (German Medical Technology Association): Annual Report 2001/2002.

Table 12: Medical Technology Companies, 1997 to 2001, Turnover, Number of Firms, Employment, (Firms with 20 or more employees only)

	1998	1999	2000	2001	2002
Total Turnover (million Euro)	9,466	9,185	10,053	11,266	11,991
Domestic Sales (million Euro)	5,123	4,833	4,963	5,303	5,414
Export (million Euro)	4,343	4,352	5,090	5,962	6,577
Number of Firms*	1,357	1,280	1,196	1,192	1,189
People Employed	83,200	79,800	79,000	82,200	84,500
White Collar	32,600	31,800	32,300	34,200	34,900
Blue Collar	50,600	48,000	46,700	48,000	49,500
% change to previous year					
Total Turnover	--	-3.0	9.5	12.1	6.4
Domestic Sales	--	-5.7	2.7	6.9	2.1
Export	--	0.2	17.0	17.1	10.3
Number of Firms*	--	-5.7	-6.6	-0.3	-0.3
People Employed	--	-4.1	-1.0	4.1	2.8
White Collar	--	-2.5	1.6	5.9	2.0
Blue Collar	--	-5.1	-2.7	2.8	3.1

* Defined as “technical parts of factory” (fachliche Betriebsteile)
Source: Spectaris based on Federal Statistical Office data, 2003

The health technology sector is still dominated by many small and medium companies (Table 13):

Table 13: Medical Technology Companies, Number of Employees and Share of Sales, 1996

Number of Employees	% of companies	Share of Total Sales
20-49	64.7%	14.7%
50-99	21.3%	13.2%
100-499	11.7%	26.3%
500-999	1.6%	16.9%
1.000 and more	0.6%	28.8%

Source: Federal Statistical Office

However, in relation to the total sales volume small and medium enterprises are not so important. Companies with less than 100 employees make up for 28% of total turnover while the 0.6% of large companies (> 1,000 employees) account for almost 29% of total sales.

The medical technology sector in Germany is strictly export-oriented and ranks no. 3 internationally behind the US and Japanese manufacturers. In 2000, the share of export equalled domestic sales the first time. Since then, export growth rate is showing a stronger trend compared to the moderate growth of domestic sales. In 2002, the data show an export share of 55 percent of total turnover and a growth rate of 10.3 percent compared with a growth rate of domestic turnover of 2.1 percent. Export sales exceed now the domestic market sales by over one billion Euro (6.6 compared to 5.4 billion Euro).

In the first half of 2002, foreign sales surplus was 1,536 million Euro. The main importing countries were (Table 14):

Table 14: Importers by Country of German Medical Equipment, 1. half year 2002

Country	Million Euro	% of total	Growth 1. half year 2002/2001 in %
USA	940	24.9	30.9
France	211	5.6	-9.8
Italy	206	5.5	-6.5
Japan	204	5.4	8.6
Netherlands	188	5.0	7.5
Switzerland	176	4.7	42.3
GB	162	4.3	-1.4
Russia	127	3.4	62.1
Spain	105	2.8	0.0
Austria	105	2.8	8.9
China	79	2.1	39.0
Others	1,266	33.6	-0.1
Total	3,769	100.0	10.0

Source: Spectaris based on Federal Statistical Office data.

3. Local Areas of Health Technology Concentration

3.1. The State of Bavaria

3.1.1. Main Characteristics of Area

Bavaria is the largest German state by area with 70,548 km² and the second-largest by citizens (about 12 million people) [see Annex 2 for an overview on German states data]. The largest cities – and main centres of industry, trade and education – are Munich (capital of the state), Nürnberg (forming a metropolitan region with the cities of Erlangen and Fürth), Augsburg, Wuerzburg and Regensburg. Bavaria is located in the middle of the European market with no European capital or economic centre more than 4 hours by plane away. The two airports of Munich and Nürnberg offer numerous national, continental and intercontinental flights.

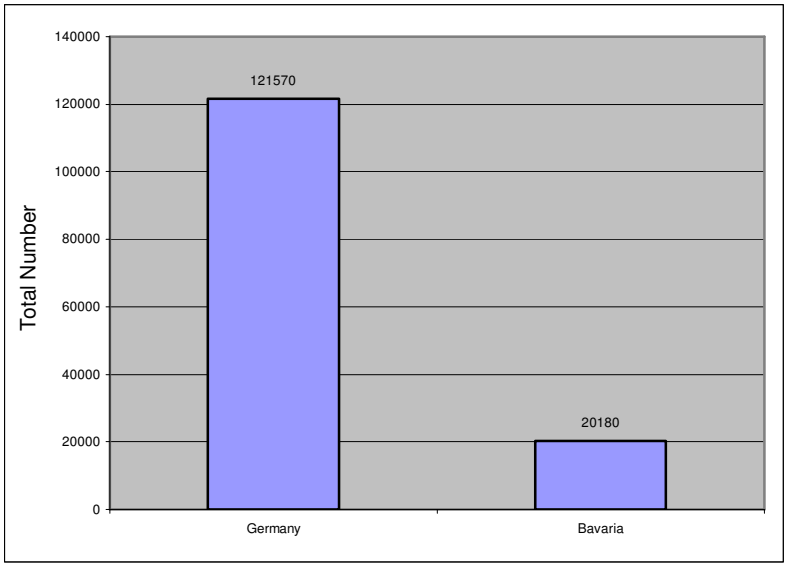
In 2001, Bavaria produced 17.3% of Germany's GNP. A total of Euro 29,103 per person compared to the German average of Euro 25,056 (STMWVT 2002, page 3).

Until the 1950s, Bavaria was a rural state with a tradition in agriculture, light industries, tourism (The Alps) and trade (Augsburg, Munich) and high unemployment (STMWVT, 2002). Heavy industries were almost solely concentrated in the Nürnberg area. Beginning in the 1960s and 1970s Bavaria started to develop to a prime spot for the banking and insurance sector and light industries, such as electrical engineering and automotive industries. Later also new technologies in the information and communication technology sector and then, today, Bio- and Medical technology started to thrive. This development was supported by and is supported in return by large companies, such as HypoVereinsbank, Allianz Insurances, Munich RE, Siemens, BMW, Audi, GlaxoSmithKline, to name just a few.
However, at the same time, middle-sized companies between 100 and 5000 employees started to become the backbone of the Bavarian economy and main driving force concerning research, job creation, and tax revenue. That is why the Bavarian Government continues to support and cater to middle-sized companies both on the state and also on the national level.
As stated above Bavaria missed with some exceptions heavy industry and mining before World War II. From today's perspective this became to be fortunate for the state after the war. At the one hand, new industries – mostly in the field of electrical and mechanical engineering – had to be developed and were thus supported by the state. At the other hand those old industries didn't become a burden upon the state's economy and finances when they couldn't compete anymore with plunging world-market prices – as it happened in other German states and former economic powerhouses such as Northrhine-Westfalia in the 1970s and 1980s.

3.1.2. Main Characteristics of Medical Technologies Sector in Bavaria

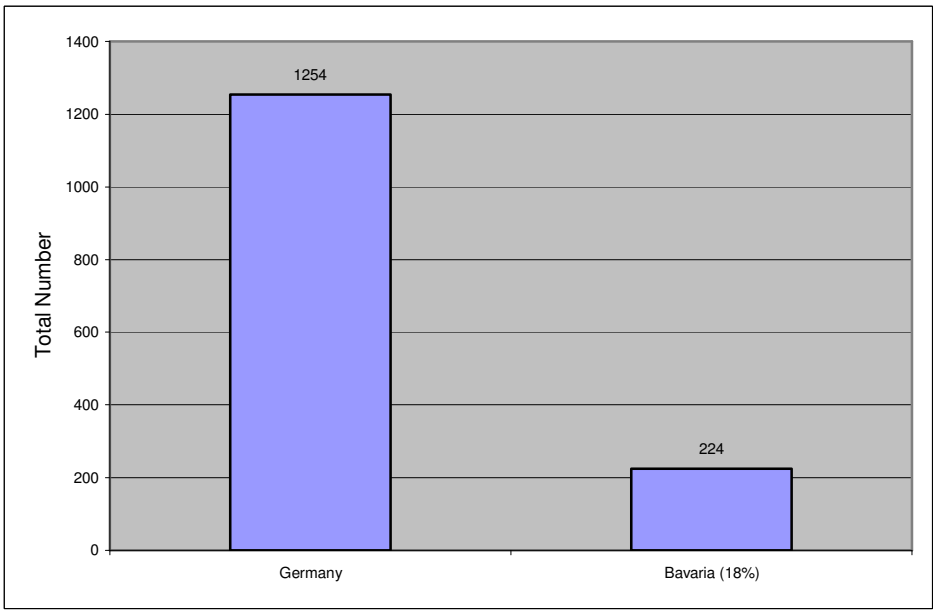
Bavaria is a centre for the medical technology industry in Germany. In 1998 more than 224 companies in this sector (about 20% of the German total) with over 20,000 employees had their headquarters in the state (also see tables in this chapter).

Table 15: Employees in the Health Technology Industry 1996, without lab diagnostics, in Germany and Bavaria



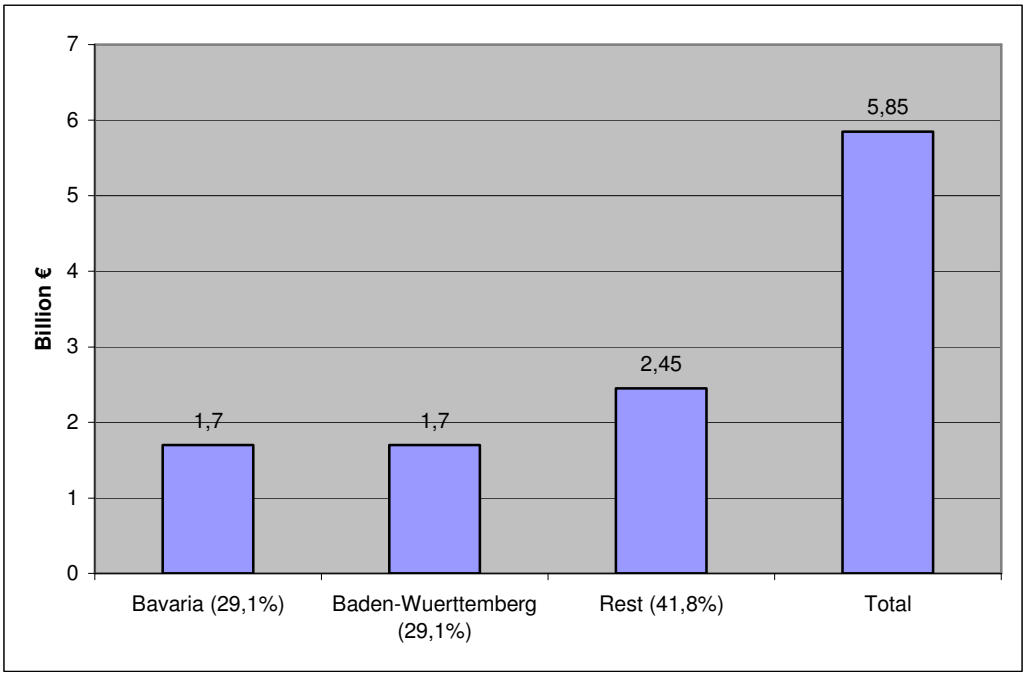
Source: STMWVT, 1997

Table 16: Number of Medical Technology Companies in Germany and Bavaria, 1996



Source: STMWVT, 1997

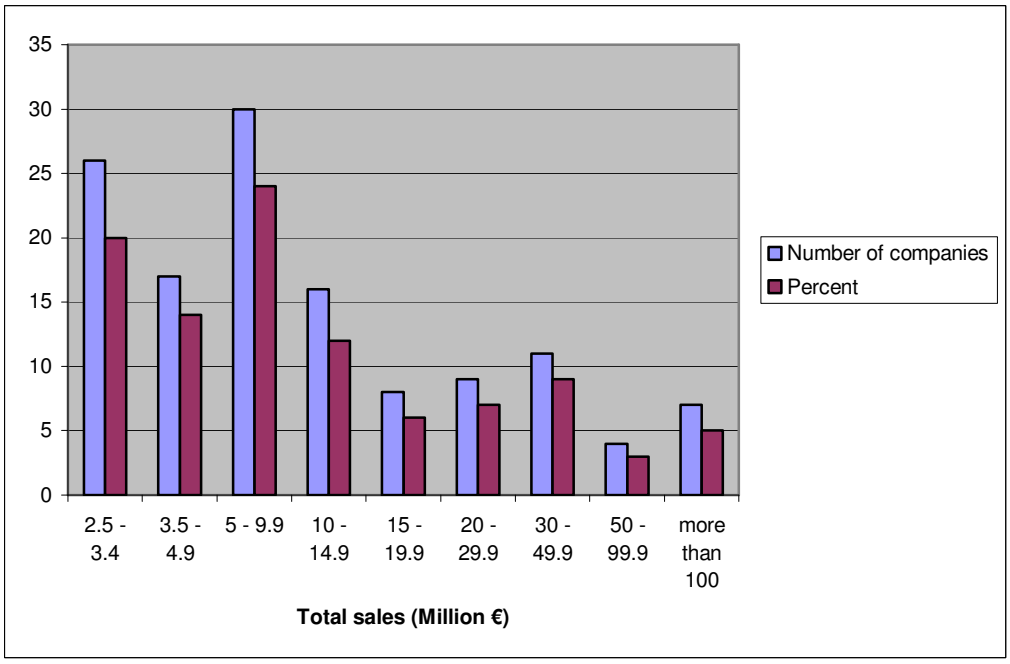
Table 17: Volume of German Medical Technology Sales (without lab-diagnostics), 1996



Source: STMWVT, 1997

14 of the 50 largest (by total revenue) medical technology and pharmaceutical companies have a main branch in Bavaria—including global players such as Siemens Medical Technology division, Baxter, GlaxoSmithKline, Novartis Pharma, and Roche. Further, a great number of middle-sized companies are located in the state (STMWVT invest I): However, about 60% of medical technology companies in Bavaria have less than 10 million Euro in annual sales (Table 18).

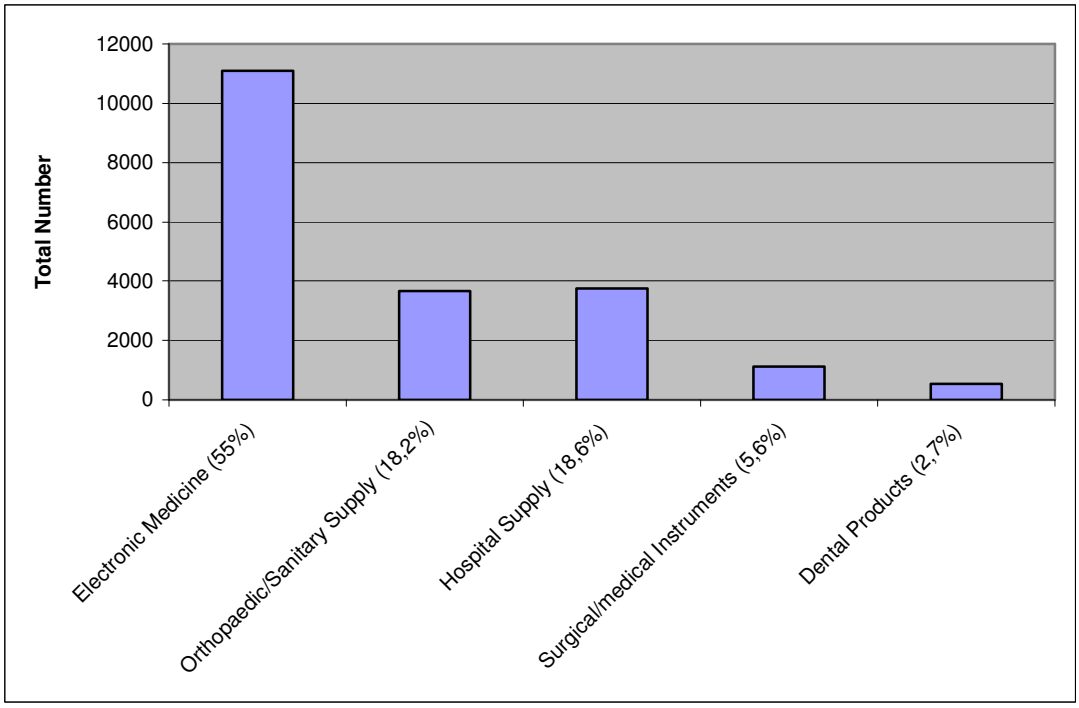
Table 18: Sales Volume and Size of Medical Technology Companies in Bavaria



Source: STMWVT, 1997

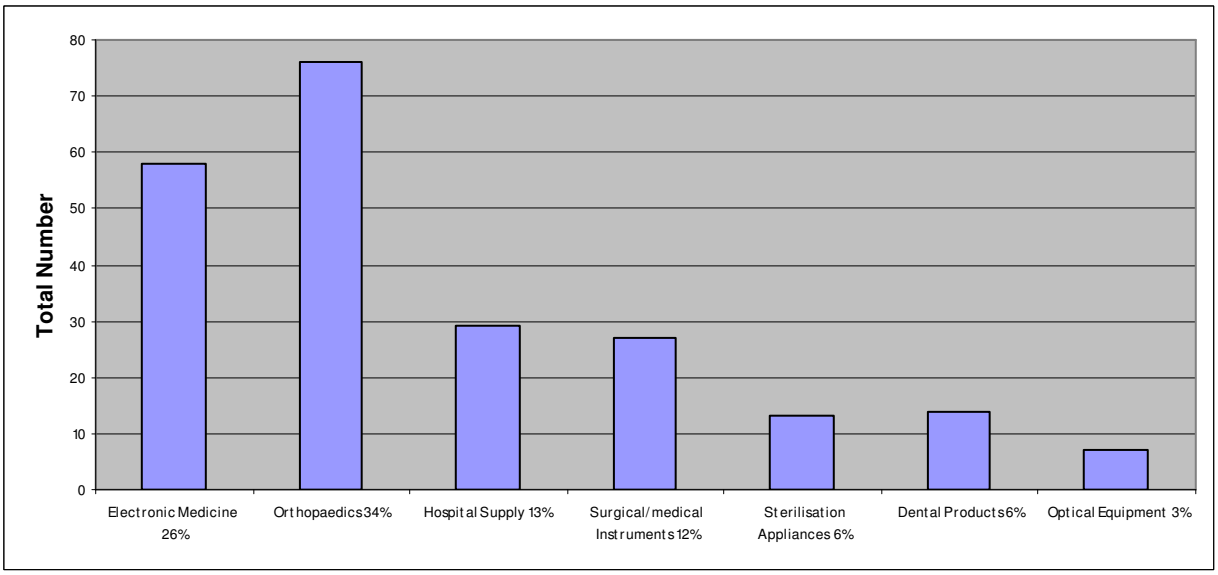
The most important product groups in Bavaria are electro-medical devices with 67% followed by orthopaedic-mechanical goods with 11% (STMWVT 1997, page 21). 50% of all electro-medical devices and 30% of Germany's medical-technological output comes from Bavaria (STMWVT invest I).

Table 19: Employees in Bavaria in the Medical Technology Sector (without lab diagnostics), 1996



Source: STMWVT, 1997

Table 20: Production of Bavarian Medical Technology Companies (without lab diagnostics), 1996



Source: STMWVT, 1997

There are two regions central to the medical technology sector in Bavaria: Munich and Erlangen, affiliated with Wuerzburg und Bayreuth/Regensburg.

3.1.3. Bavaria's Assistance for Medical Technology Industry Development

Key element of the success of the health technology sector in Bavaria is what the Bavarian Ministry for Economics, Transport and Technology (STMWVT invest I) calls a "quick transfer of technology". It is the state's goal to bring companies and researchers together to promote aggressive research and successful product innovations.

Exceeding the state's normal annual business development budget of 500 million Euro, the state invested an additional 4 billion Euro since 1994 in education, research, technology transfer, entrepreneurship and the specific business fields of ICT, new materials, environmental and medical technologies and mechatronics. This happened mainly through two state programmes: "**Offensive Zukunft Bayern**" (starting 1994 with a budget of about 2.8 billion Euro) and "**High-Tec Offensive**" (starting 2000 with a budget of about 1.35 billion Euro) (STMWVT, 2002). The enormous financial support was possible through a large sale of shares of former state-owned companies by the state of Bavaria in the middle of the 1990s.

At the one hand, research and information networks are promoted: The *Forum MedizinTechnik und Pharma (http://www.forum-Medical technology-pharma.de)* was founded to act as an information nod between all stakeholders in the sector: large and small companies, investors, academic researchers and hospitals. Until the *Forum's* founding, a matching problem existed because there was a lack of connection between scientific ideas and investment capital. Further, a *Working Group of Bavarian Research Networks (Arbeitsgemeinschaft der bayrischen Forschungsverbuende www.abayfor.de)* was founded that brings together researchers of all disciplines including the medical technology branch and connected sectors. The *Bavarian Research Foundation (Bayrische Forschungsstiftung)*, a long time establishment to finance single research projects equally with capital from the private sector, is also embedded in this strategy.

At the other hand, four **regional competence centres** were defined and are intensely supported by the Bavarian Government:

- Erlangen/Nürnberg is the seat of Siemens' medical technology division. It's the centre for medical technology in Bavaria, especially imaging methods and virological and pharmaceutical research. The state's engagement in this area is especially strong because the district has structural problems and relatively high unemployment rates. Erlangen/Nürnberg is furthermore integrated in the nation-wide *competence-network project (Kompetenznetze, www.kompetenznetze.de)* funded by the *Federal Ministry for Education and Research.*
- In München the universities with their attached hospitals are the centre for institutionalized research. For further technology transfer, the *Max-Planck-Research-Institutes (MPI)* for biochemistry, neurobiology, and physics that have their seats in Munich, are integrated. The MPIs are a Germany-specific public-private research partnership. The *Research Centre for the Environment and Health (Forschungszentrum fuer Umwelt und Gesundheit, GSF)*[20], is integrated as well.

[20] The GSF belongs to the *Helmholtz-Research-Societies* (similar the *Max-Planck-Institutes*). See also footnote 2 and 23. The GSF's goal is to „identify health risks for hu-

- Regensburg and Würzburg, both cities with universities, cooperate closely with Erlangen/Nürnberg.

A more detailed analysis of these localities, including the local setup and cooperative processes, will base on the results of the case studies.

3.1.4. Linkages to Other Industries (locally, nationally, internationally)

While in Anglo-Saxon countries, especially the United States, the terms biotechnology and medical technology are combined to the genus "Life Sciences", the situation is different in Germany.
Traditionally the medical technology industry is linked to the electrical engineering and precision mechanic faculties and companies as Siemens seem to be a good example. Biotechnology instead is counted among the biological and chemical disciplines, both concerning education and entrepreneurship.

As stated above 14 of the world's largest companies have a seat in Bavaria. The great number of middle-sized, national companies is also located in the area or the close vicinity, namely the state Baden-Württemberg (see the next chapter). Also as stated above, Bavaria (and especially Baden-Württemberg) is the centre for the manufacturing industry with a tradition in electrical engineering and other light industries. Medical technology companies residing in the area, whether big or small, can consequently profit from an inter- and intra-industry network, spanning the area, Germany and the world. This network also includes research institutions and universities.

3.1.5. The Importance of Local Skills Supply

Because education falls under the states' legislative rights, the level of education differs from state to state with the more southern states achieve better scores as the northern or eastern states. Bavaria and Baden-Württemberg always perform very good in international comparisons, such as the PISA study where Bavaria was able to rank very high while Germany as a whole showed enormous deficits.

Bavaria has
- nine public *general universities* (Augsburg, Bamberg, Bayreuth, Erlangen-Nürnberg, Munich [Ludwig-Maximilians-University und Technical University], Passau, Regensburg und Würzburg) and
- 17 public *universities of applied sciences* (Amberg-Weiden, Ansbach, Aschaffenburg, Augsburg, Coburg, Deggendorf, Hof, Ingolstadt, Kempten, Landshut, Munich, New-Ulm, Nürnberg, Regensburg, Rosenheim, Weihenstephan, Würzburg-Schweinfurt).

Although most of these institutions do not offer a specific degree in medical technologies, they guarantee an ample supply of engineers, biologists, chemists, physicists, and doctors. Types of courses vary from university to university: some offer their students to specialize in medical technology within their general studies (e.g. electrical engineering); others offer an entire medical technologies master programme. Just recently the new *Institute of Medical Technology* was founded by the Munich's Technical University. It is a graduate programme including classes,

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mans and the ecosystem, to estimate the environment's capacity for usage and to develop concepts to avoid lasting damages".

among others, in biocompatible materials, physiology, quality, management, law, biomechanics, optomechatronical measurement systems, telemedicine, macromolecular chemistry, etc. (http://www.zimt.tum.de/). At *Munich's University of Applied Sciences* a specialization programme exists within the courses or microelectronics, at *Ansbach's* there is one within the course programme for industrial engineers.

Furthermore Technical Schools in Regenstauf and Ansbach offer courses to become a *state-approved technician for medical technologies (Staatlich gepruefter Medizintechniker)*.

The survey and the case studies will further clear whether companies situated in the region rely on the region's schools to supply enough experts for their recruitment. They will also help to understand how industry and educational institutions interact today and have interacted in the past to create and promote new kinds of course programmes.

3.2. The State of Baden-Württemberg

3.2.1. Main Characteristics of Area

Baden-Württemberg shares its eastern boarders with Bavaria and its western boarder with France. 10,537,000 people live in this state encompassing an area of 35.751 km². Baden-Württemberg consists of various regions that were united after World War II to today's state. That is the reason why the state does not have a large and "leading" city. The capital is Stuttgart with roughly 550,000 citizens. Karlsruhe, the next largest city, has about 420,000. Other centres are Freiburg (200,000) and Ulm (112,000). In these cities' vicinity and suburbs lives most of the population, so the density of population is fairly high at about 300 persons per square kilometre. Just like its eastern neighbour, Baden-Württemberg is located in the middle of Europe with no European capital or economic centre more than 4 hours by plane away.

In total 4.977 million people work in the state, 4.450 million of them are state or privately employed (Argedonau, 2003). Compared to other German states, the share of self-employed is not one of the highest. Baden-Württemberg produced 2001 a GDP of 307 billion Euro, which is about Euro 28,920 per person (the German average being Euro 25,650, see Annex 2).

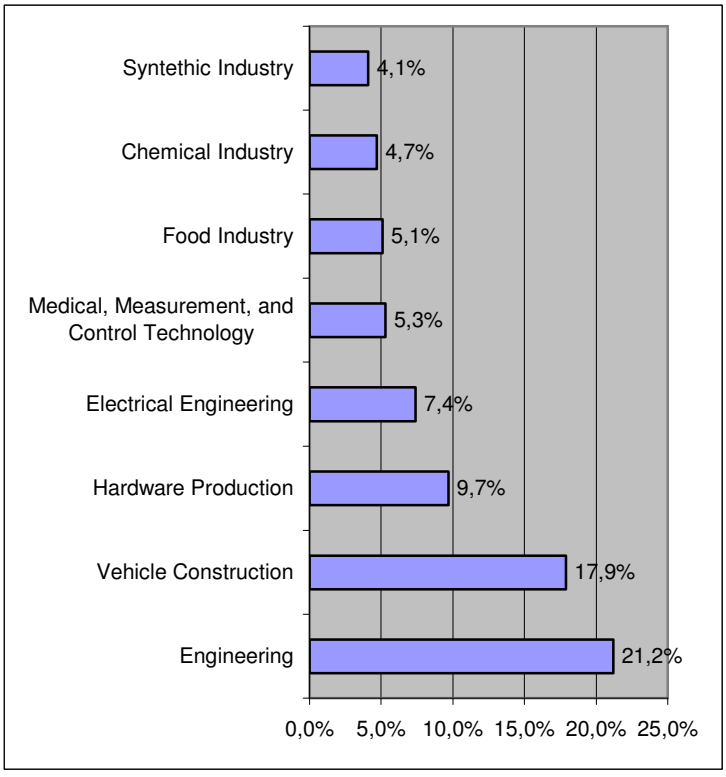
The area has a long tradition in manufacturing, engineering and generally, light industries: be that cotton and time-piece manufacturing starting in the 18th century, hardware production and steam engine and motor (Benz, Daimler) construction in the 19th century and then airplane and automobile manufacturing in the 20th century. The area also saw an early engagement of the state in education: in 1825, Germany's first *Technische Hochschule (Technical University)* was founded in the city of Karlsruhe, in 1850 the *Staatliche Uhrmacherschule (State-run school for clockmaking)* in Furthwangen. In 1889 the state also started to support the training of apprentices. Similar to Bavaria, the lack of raw materials hindered the development of mining and heavy industry and fostered light industries in return.

Although there have also been large enterprises in Baden-Württemberg, such as Bosch, Porsche, SAP, Heidelberg Printing Systems, and what is today Daimler-Chrysler, the economic backbone of the state have always been and continue to be small and medium-sized companies. Today also large international companies are located in Baden-Württemberg such as IBM, Hewlett-Packard, Sony, or Pfizer.

The highest amount for research and development is spent in Baden-Württemberg compared to all other states in Germany (11 billion Euro in 1999; see Annex 2). Over 78% of the 11 billion are contributed by state's companies R&D expenditures, 10.5% from university research and 10.7% from non-university research organisations (with both last-mentioned a declining tendency). The enterprise engagement in R&D in Baden-Württemberg is above average compared to all other German states and makes up for almost a fourth of all R&D expenditures in the private sector in Germany.

Today, over 50% of all employees in the state are working in engineering, vehicle construction or hardware production, as (Table 21) shows.

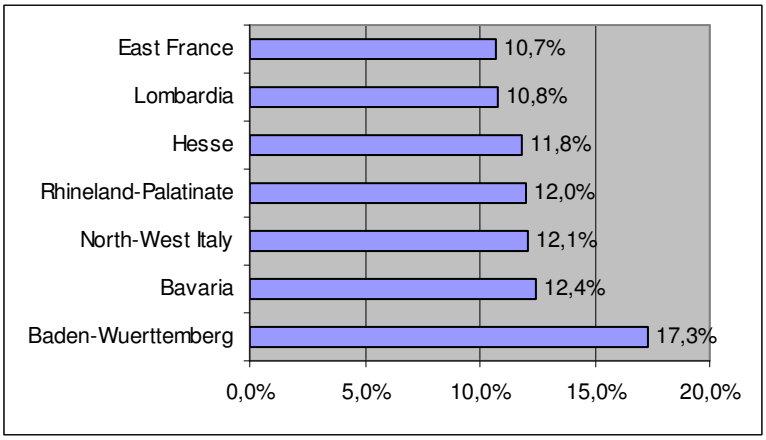
Table 21: Employees in Baden-Württemberg by Sector of Industry, 2000



Source: http://www.wm.baden-wuerttemberg.de/htm/bereich3/content3_5.htm

This tradition of engineering translates to Baden-Württemberg today as a (high-) technology- and innovation-driven economy. Table 22 compares shares of high-tech employees in selected areas of middle Europe.

Table 22: Share of Employees in High-tech Industries in Selected European Regions



Source: http://www.wm.baden-wuerttemberg.de

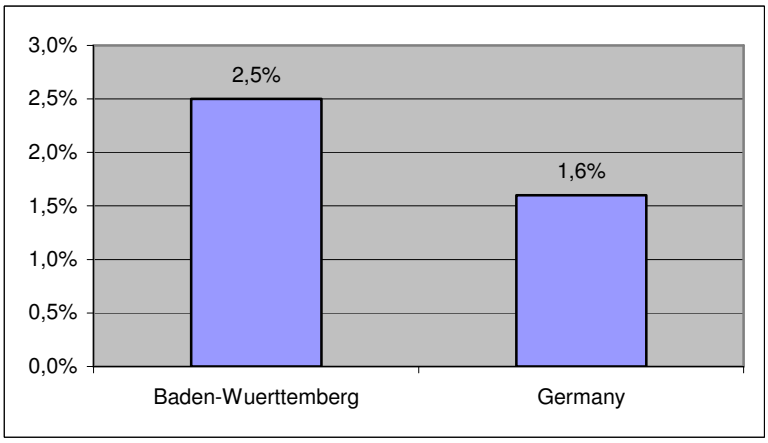
Baden-Württemberg depends highly on exporting its goods: A third of the state's workplaces depend on exports. The export volume of the state is Euro 8,100 per person, with the German average of Euro 6,800 (Japan US$ 3,000, USA about US$ 2,500). About 1.7% of the world's exports come from Baden-Württemberg.

3.2.2. Main Characteristics of Medical Technologies Sector

As stated above, the traditional strongholds of the state are engineering, vehicle construction and electronic engineering. Furthermore, the annual 112 patent registrations per 100,000 inhabitants in the state is the highest European number. With this background the state of Baden-Württemberg tries to gain a strong position in the technical fields of microelectronic, ICT, biological, technologies and medical technologies to stay attractive as a production site in a globalizing economy.

Relative R&D spending (4% of the GNP) of the state is above this of Germany (2.3% in average), the United States or Japan; enterprises in the state have above-average R&D expenditures—about 17% of their annual expenditures—and also employ more people than normally in R&D positions (Table 23).

Table 23: Share of Employees in R&D Positions: Baden-Württemberg and Germany



Source: www.bw-invest.de

As Table 17 already showed for Bavaria, Baden-Württemberg produced as well 29,1% of Germany's total production in the medical technology sector in 1996 (without lab-diagnostics).

Baden-Württemberg has a good stand as a location among the European medical technology industry: industry and research meet to produce a great variety of products. About 50% of Germany's manufacturers in this sector are based in the state. There are multi-national companies with a great variety of products as well as small companies, which might only offer a single product. Within the state, Tuttlingen and Tuebingen-Reutlingen are the centres of the medical technologies sector. The former being home to about 400 companies, the later to about 200, both suppliers and OEM's. According to bw-invest a state network of technology transfer centres provides the bridge between private industry and research institutes and guarantees rapid access to new results.

Another centre of the sector is the *Research Centre Karlsruhe* that has an own subdivision for medical technology (http://www.fzk.de/as-med/).

Almost every product group within the sector is produced in the state: Anaesthetic products, surgical instruments, sterilisation supply, diagnostic instruments, imaging diagnostics, implants, lab supply, radio-, laser- and ultrasonic-therapy, etc.[21] However a specialization in minimal invasive surgery supply can be noticed (see next chapter).

Currently, a trend towards an integrated portfolio of product and solution can be witnessed among the companies in the sector. Although they still feel themselves technically superior to their world-wide competitors, the companies observe competition from cheaper production sites around the world. To further be able to finance high labour cost they must sell services as added value to their products[22].

3.2.3. The State's Activities for Medical Technology Development

Just as the state of Bavaria, the state of Baden-Württemberg sees technology transfer as key issue in creating a strong innovation and technology development. A 100 page report of the State Ministry of Science, Research and Arts ("Strategies for the Baden-Württemberg Research Policy") from 2000 gives a clear analysis of strengths and weaknesses of the research sector in Baden-Württemberg and defines the most important areas of action for the state. However, as our initial research indicates, the state is not yet fully organized in cope with the found deficits. A Roland Berger Strategy Consultans' study also states that "In Baden-Württemberg various enterprises or public institutions of the health branch belong to the market leaders in their sector. However, the potential for synergies that lays in an early integration of these branches remains unused. The historically grown boarders between these branches – such as Medical Technology, Fitness, Home Care, (...) Pharma, wholesale, etc. – are still too strong" (Roland Berger, page 52). Further research, especially detailed interviews with executives in the organisations that are named in the next paragraphs, will hopefully allow a more detailed

[21] A complete list can be found at www.bw-invest.de.
[22] Further reading: Fraunhofer Gesellschaft ISI: www.isi.fhg.de/pi/projekte/sa_lb_bwz.htm

and understandable view on the situation in Baden-Württemberg, especially as far as the medical technology sector is concerned.

Next to its (limited) research policy the state is engaged in local marketing. To better handle issues of site marketing, the Ministry for Economic Affairs of Baden-Württemberg founded the *Society for International Economic Cooperation Baden-Württemberg (Gesellschaft fuer internationale wirtschaftliche Zusammenarbeit Baden-Württemberg)*. Its premier goal is new business development of new technology enterprises in Baden-Württemberg. Doing so, it helps both foreign companies that want to invest in the state as well as companies from the state to invest abroad. Its services range from giving country information over finding premier locations and grounds for new businesses up to dedicated market research. It is financed through the state and the *State Association of Industry (Landesverband der baden-württembergischen Industrie e.V.)*. A dedicated employee is responsible for the medical technologies sector.

Another, however general, catalyst for the development of the industry is the strong research environment in Baden-Württemberg. It is estimated that in the state about 8 billion Euro are annually invested in research. About 20% of all *Max-Planck-Research-Institutes* and 30% of the *Fraunhofer-Research-Institutes*, as well as 25% of the research capacity of the *Hermann von Helmholtz-Society of German Research Centers*[23] are located in the state. About 100 research centres exist in the state that do not belong to an university. However, they are connected with them through public or private initiative, for instance, through the initiative *Competence Networks (Kompetenznetze.de)*, a cooperation between the German Federal Government and the single states.
In the city of Karlsruhe 94 out of 1,000 industry employees are in research and development functions. This is the highest number in Europe. Within *Competence Networks* Baden-Württemberg supports a *Research Centre (Forschunszentrum Karlsruhe)* in the city that focuses on science and engineering. A subdivision is especially dedicated to medical technologies and profits highly from the possibility of close inter-disciplinary research with other divisions of the Centre and the city's university.

Also under the label of *Competence Networks,* the state is today engaged in the two areas Tuttlingen and Tuebingen-Reutlingen, as mentioned above. These two areas developed over the course of the last 130 years a world-wide unique concentration of about 600 companies specialized in surgical instruments. Over the last 15 years those mainly middle-sized companies started to widen their portfolio of medical technological products; at the same time they also specialized in instruments for minimal invasive surgery, supported by working groups of the University Hospitals of Tuebingen and Stuttgart. However, a systematic coordination between medical, technical-scientific and industrial actors was missing. The *Competence Centre Minimal Invasive Medicine & Technique (Kompetenzzentrum Minimal Invasive Medizin & Technik, MITT)* was founded in 2001. This non-profit organization has as goal the advancement of medical-technical sciences, further education in the field of Medical Technology and technological transfer between universities

[23] All named institutions belong to public-private research partnerships that form the third pillar of research in Germany besides all-public research in universities and all-private research in enterprises (see footnote 2)

and enterprises in the sector. Although supported by the state, the initiative for this *Competence Centre* came from universities, companies and hospitals.

Preliminary one can say that the development of the sector in Baden-Württemberg to its state today is mainly grounded on historical reasons and, if any, initiatives from universities, research institutes and private enterprises. The state's role was – compared to Bavaria – of minor extent. However this seems to change or has changed in the very recent past.

3.2.4. Linkages to Other Industries (locally, nationally, internationally)

As stated above, Baden-Württemberg is traditionally a stronghold of middle-sized companies in manufacturing and engineering with an emphasis on research and innovation. Cross-industry linkages within the state were necessary for the sector to develop as it did.

The many middle-sized companies can be called global-players since their export quota is high and some are world-market leaders in their field. Furthermore, today, there are also large and multi-national companies from all sectors of industry in the area. Hewlett-Packart, IBM and SAP were named already above. Close-by Bavaria is the German centre for the software and multi-media industry. This offers the opportunity for linkages to the IT-sector.

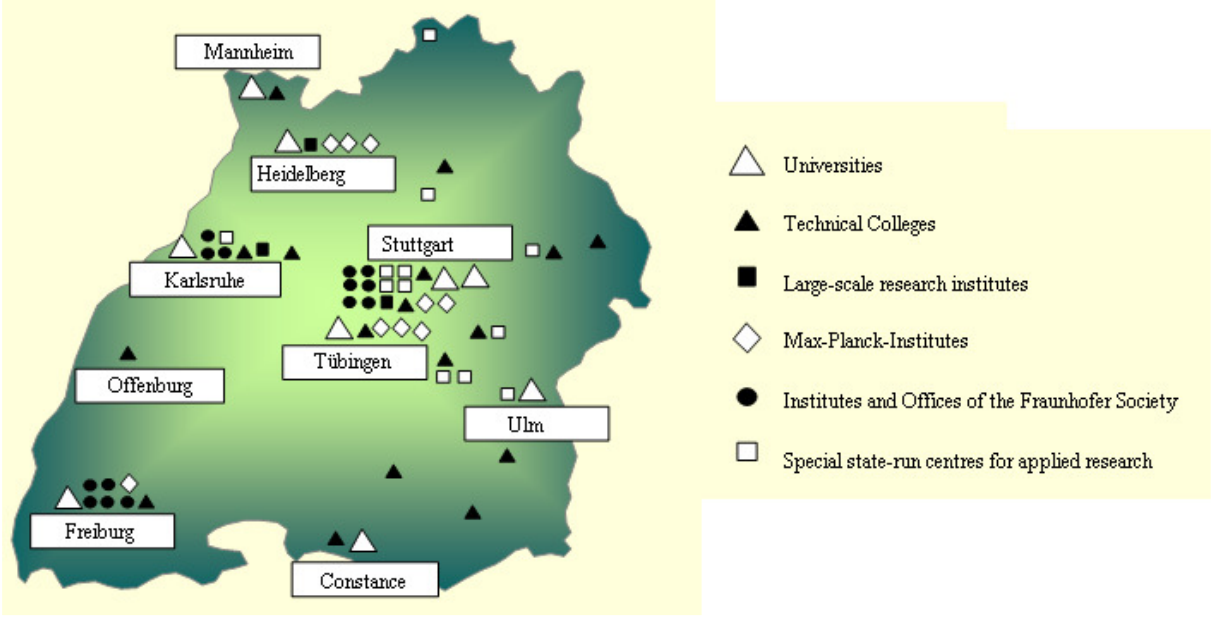
Since the medical technologies sector is by its nature inter-disciplinary, linkages do exist. However, these linkages could still be improved.

3.2.5. The Importance of Local Skills Supply

Baden-Württemberg is the German state with the highest density in educational institutions. There are two *technical universities* in Karlsruhe and Stuttgart, seven *general universities* in Freiburg, Heidelberg, Hohenheim, Constance, Mannheim, Tuebingen und Ulm. There are 37 *universities of applied sciences*, eight *universities of cooperative education*, three large research institutions, 14 *Max-Planck-Research-Institutes*, 14 research institutes of the *Fraunhofer Societies* and ten institutions in cooperation with the private sector. Altogether, over 100 non-university research organisations are located in the state with plenty of links to the university landscape. Figure 2 gives a geographical overview of the density of research and educational institutions in the state.

In Baden-Württemberg there is no dedicated course programme for the medical technologies sector. However, there are many courses in various disciplines where students can specialize in the field of medical technology—while still earning a general degree in, for instance, electrical engineering. Furthermore Technical Schools in Esslingen and Heidelberg offer courses to become a *state-approved technician for medical technologies (Staatlich gepruefter Medizintechniker)* .

Figure 2: Geographical Overview of Baden-Württemberg's Research and Educational Landscape



Source: gwz.de

After looking at Figure 2, it is obvious that an interrelation exists between the educational infrastructure in the state and the prospering manufacturing industry respectively the medical technology industry. Interviews will even further clear whether companies situated in the region rely on the region's schools to supply enough experts for their recruitment.

A detailed list of skills that are required by medical technology companies can only be given after interviewing health technology companies of different size and specialisation. It also remains unclear whether there was indeed a lack of skilled personnel in Bavaria or/and Baden-Württemberg in the last years and if there was, whether it inhibited the industry to prosper. These questions can only be answered when the survey and interviews in the relevant companies have been conducted.

4. Conclusion

In spite of the structural problems in many areas, a high level of innovation, high value added production and product differentiation are still characteristics of many German manufacturing branches including the medical technology sector. The high labour productivity resulting from these facts appears to depend only in parts on the technology content of the capital stock but arises predominantly from the broad human capital endowment. By tradition, German companies invest into human capital through vocational training of the young generations and thus can rely on a broad supply of skills at the intermediate level. The internationally well-known system of Dual Training which is the institutional backbone of vocational training in Germany has far-reaching effects: Beyond its positive effects on labour productivity it allows companies to apply complex production technologies, to enhance the quality of products and services, and to approach the high-price segments of the world markets.

Also in contrast to other countries, vocational training is perceived as a public good rather than a private investment. Still supported by a broad consensus among the social groups, the Federal and Länder governments are financing professional training at vocational schools, colleges and universities. The multitude of commercial chambers, employers associations and trade unions are involved in the organisation of dual and continuing training. Companies are investing into the training of young people and their experienced staff with little fear of poaching because the labour market generally provides a sufficient number of trained workers. To some extent training is accepted by businesses as a social commitment with high returns from micro- and macro-productivity. For individuals, finally, training is an asset to be competitive on the labour market.

However, for almost a decade “Facharbeitermangel” (lack of qualified workers) and missing high-end qualified people are a problem for many companies that hinders to occupy important openings and in the course threatens their innovative power. The above mentioned education and qualification system was not able to overcome the stable mismatch in qualification profiles between unemployed people on the one hand and vacancies on the other hand. Although IT was affected most by the lack of qualified workers at the end of the 1990s (that finally led to the German “IT Green Card” system), medical technology companies were also suffering, mainly because of a shortage of engineers, craftsmen and technicians and other specialised professions.

The survey and the case studies will give a deeper understanding if and how the shortage of skilled workers and the mismatch of qualification on the labour market are influencing the German medical technology sector. More specific, the main question is how the labour market restraints contribute to the economic development, innovative strength, and future expansion of medical technology companies in the defined regions. In addition, the regional aspect of the study gives the opportunity to incorporate historical developments with the educational environment and current regional and local policies of the state governments. The endeavours of the responsible units (as the Federal and State governments, the Federal Employment Service with its extensive training offers, industry associations or training institutions) to learn more about future qualification needs and accordingly

direct the education and training system will be analysed in the upcoming report as well.

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www.gwz.de

For Baden-Württemberg's history: www.pantel-web.de/bw_mirror/history/history.htm.

For information on Competence Centres: www.kompetenznetze.de

Federal Statistical Office: www.destatis.de

OECD for basic data: www.oecd.org/dataoecd/8/4/1874420.pdf

Federal Ministry for Education and Research: www.bmbf.de

Annex 1

GDP and Health Expenditures in Germany 1992-2001

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Population	Million	80.6	81.2	81.4	81.7	81.9	82.1	82.0	82.1	82.3	82.4
GDP*	Billion Euro	1,613.2	1,654.2	1,735.5	1,801.3	1,833.7	1,871.6	1,929.4	1,978.6	2,030.0	2,073.0
Growth Rate GDP	%	7.4%	2.5%	4.9%	3.8%	1.8%	2.1%	3.1%	2.6%	2.6%	2.2%
Health Expenditures	Billion Euro	163.2	168.1	180.2	194.0	203.0	203.9	208.4	214.3	218.8	225.9
Growth Rate Health Exp.	%	--	3.0%	7.2%	7.7%	4.6%	0.4%	2.2%	2.8%	2.1%	3.2%
Health Expenditures as share of GDP	%	10.1%	10.2%	10.4%	10.8%	11.1%	10.9%	10.8%	10.8%	10.8%	10.9%
Health Exp. Per Capita	Euro	2,020	2,070	2,210	2,380	2,480	2,480	2,540	2,610	2,660	2,740

*at current prices
Source: Federal Statistical Office, Ministry for Health and Social Security

ANNEX 2

Basic Data of German States 2002 (Bundesländer)

	Population in 1.000	GDP in million Euro	GDP in % of Germany's GDP	GDP 2002/2001 change in %	GDP per capita in Euro	R&D expenditures in billion Euro (1999)	Unemployment Rate %	Labour Force Participation Rate Female %	Labour Force Participation Rate Male %
Baden-Württemberg	**10,601**	**307,443**	**14.6**	**1.9**	**28,920**	**11.0**	**5.4**	**66.7**	**82.0**
Bayern	**12,330**	**368,917**	**17.5**	**2.3**	**29,858**	**9.6**	**6.0**	**67.1**	**82.3**
Berlin*	3,388	77,131	3.7	1.2	22,756	2.8	16.9	68.6	77.8
Brandenburg	2,593	44,117	2.1	1.2	17,054	0.7	17.5	73.8	80.1
Bremen*	660	22,962	1.1	2.3	34,753	0.5	12.6	61.6	77.4
Hamburg*	1,726	75,178	3.6	2.2	43,556	1.3	9.0	66.6	79.0
Hessen	6,078	191,610	9.1	1.9	31,496	4.5	6.9	65.3	80.8
Mecklenburg-Vorpommern	1,760	29,611	1.4	1.5	16,891	0.3	18.6	70.8	78.2
Niedersachsen	7,956	183,124	8.7	1.5	22,977	4.0	9.2	61.9	79.0
Nordrhein-Westfalen	18,052	463,963	22.0	1.3	25,690	7.8	9.2	59.7	78.8
Rheinland-Pfalz	4,049	93,300	4.4	2.5	23,038	1.9	7.2	62.2	80.6
Saarland	1,066	25,432	1.2	2.6	23,878	0.2	9.1	58.0	78.0
Sachsen	4,384	75,793	3.6	2.1	17,358	1.7	17.8	72.4	79.8
Sachsen-Anhalt	2,581	43,314	2.1	1.8	16,886	0.5	19.6	72.5	77.9
Schleswig-Holstein	2,804	65,637	3.1	1.8	23,362	0.7	8.7	64.5	80.7
Thüringen	2,411	40,667	1.9	1.3	16,929	0.6	15.9	71.9	79.5
Germany	**82,440**	**2,108,200**	**100.0**	**1.8**	**25,562**	**48.1**	**9.8**	**65.3**	**80.1**

* so called city-states that are not directly comparable with the other Länder

Sources: Statistisches Landesamt Baden-Württemberg; Statistisches Bundesamt 2003