



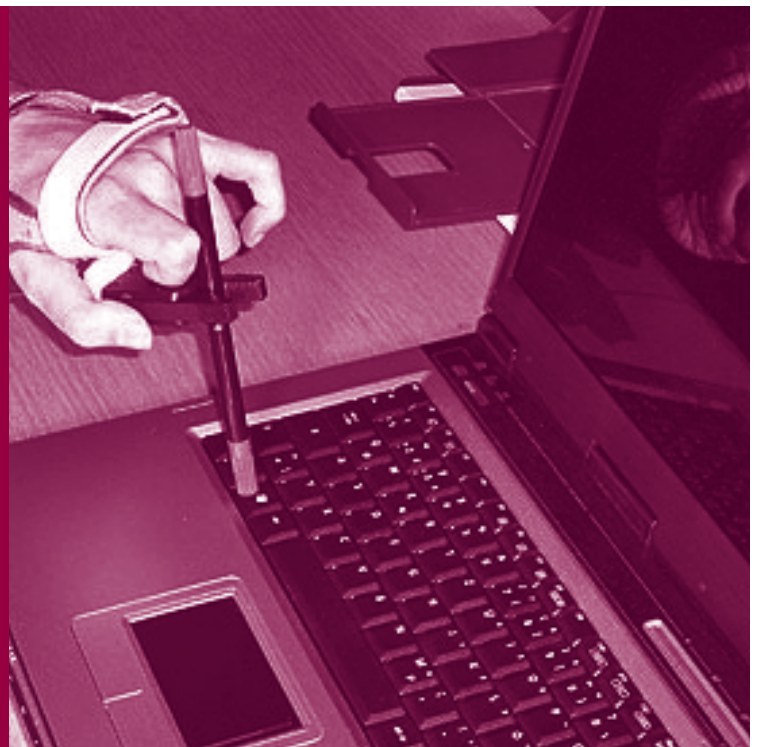
OFFICE OF TECHNOLOGY ASSESSMENT  
AT THE GERMAN BUNDESTAG

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# Technologies in the context of disability compensation at the workplace

Summary

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## SUMMARY

There are currently 8.6 million people in Germany with a disability, half of whom are of working age. Setting policies for the disabled is thus not a topic for a minority but an organizational task of all of society. The paradigm shift in the past few years away from the principle of welfare towards (more) autonomy and participation led to reform of the German disability law in 2001. One important prerequisite for more autonomy is the permanent participation – at least as permanent as possible – in working life, which often means much more to those with disabilities than merely their own financial livelihood. There are still considerable differences between those with and without disabilities with regard to equal rights in participating in working life. For example, people with disabilities who are between 15 and 65 years of age are more strongly affected by unemployment. International comparisons show that their employment rates in Germany are low and that they are less successful at maintaining employability in Germany than such groups are elsewhere, particularly in Scandinavian and Anglo-Saxon countries. The development and increased use of accessibility technologies is thus bound up with the hope of tapping previously unused potential and of improving the participation options of the disabled.

The TAB project »Disability Compensating Technologies (DCT) at the Workplace« was commissioned by the Committee for Education, Research, and Technology Assessment at the German Parliament at the suggestion of the Committee for Labour and Social Affairs. The scientific and social dimension of the topic was developed with the focus on several main points by describing the technologies currently available and those innovative developments on the horizon to compensate for or reduce individual functional restrictions. In addition, it presents the framework of the constitution and of social legislation and social policy for DCT at the workplace, structures that promote or inhibit this, and selected social aspects and economic consequences of the further development and spread of accessibility technologies. The technology assessment project concludes with the present final report.

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## DISABILITY COMPENSATING TECHNOLOGIES

According to the German Social Code (Sozialgesetzbuch), a person is considered disabled if his or her bodily function, mental capacity or emotional health deviates from the condition typical for a person of that age and is therefore impaired in his or her participation in social life. This definition combines two compo-



nents: the individual with his or her specific (relatively restricted) abilities and his/her environment or surroundings, in which he or she can only participate to a limited degree – in comparison with people without disabilities.

From this perspective, in the present report it is a question of how technology can best support individual abilities and how it can be employed to shape environmental conditions so that they represent the smallest possible barriers to participation for disabled people, in particular in working life. In this connection, the focus is not only on technology in the strict sense, i.e. not only on the mostly technical objects and devices, but also on the abilities and skills (technology in the broader sense) that are needed to be able to employ these technologies efficiently.

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## STRUCTURE OF THE REPORT

There are many different kinds of accessibility technologies because these are intended to serve as the links between a very heterogeneous user group and an equally diverse set of requirements relating to the workplace. The structure of the report follows the two criteria »Type of functional restriction« and »Type of technology«.

### *Type of functional restriction*

The degree to which technology can improve or permit participation in working life currently differs according to the type of impairment to body structures and functions. Assistive technologies can today primarily compensate for a restricted capacity to *move*, *see* or *hear*. The report gives examples of these functional restrictions of the particular challenges facing affected individuals in similarly exemplary workplace situations and how technology can be implemented here to compensate for it.

### *Functionality of the technology: assistive technology for the individual and universal design*

Technologies promoting disability compensating can be distinguished according to their respective targets (individual or environment). *Assistive technologies* are those which address the individual and his or her functional restrictions and aim to compensate for them, while the techniques which are tied to environmental conditions are referred to in German as «barrier-free design» and grouped together internationally under the concept of *universal design* – while the term

*DCT* is used in this report in a more general sense. Although assistive technologies and universal design adopt different approaches, they should be related to each other and be complementary. It is often the case that assistive technologies are such a prerequisite for compensating for individual functional restrictions that without them participation in working life would be impossible.

*Assistive technologies* primarily attempt to compensate directly for specific functional restrictions (e.g. prostheses, glasses). If this is not possible, their aim is to make (compensatory) access as equal as possible in another way (e.g. wheelchair, Braille). Particularly the use of prostheses can be associated with various degrees of physical intervention for the individuals affected (e.g. hearing aids in the ear or implanted in the skull) and in the ideal case prevent a disability. These assistive technologies are not only objective artefacts in the sense of hardware but increasingly also operating systems and software that are required for the actual product to be used. In this regard it is also important to mention necessary services (ranging from one-time support to regular personal assistance). A service such as this is often the prerequisite for the technology to provide an individual with a specific capacity – the real prerequisite for participation in working life.

In *universal design*, we distinguish between solutions that relate to the immediate environment of the individual (home environment or workplace) and those that make particular environmental areas (e.g. buildings, devices and information) more accessible to all people – even those with different disabilities (e.g. barrier-free public transport or communication systems). As a result, these areas should be as accessible and free of barriers as possible for all potential users, regardless of the type of disability. The criteria for barrier-free access here follow the approach of keeping the physical and psychological requirements on the user as low as possible and where feasible allowing alternative methods of operation.

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## APPROACHES FOR DCT

The diversity of specific and in particular of assistive technology products available is continually increasing. The distinction between these and other, «normal» implements is becoming increasingly difficult due to the principles behind universal design and freedom from barriers. This can be observed currently especially in the area of information and communication technology (ICT). Using case studies, we designate existing DCT for various functional restrictions and outline the development that is becoming apparent. The basic assumption in describing the case studies mentioned in the report is that the specific professional requirements can be transferred to other professional fields. Using these case



studies, the report describes the technical options and limitations in order to demonstrate the options for action which could lead to a further improvement in participation for those affected.

### Case studies of DCT at the workplace

#### > *Impaired Locomotor System*

- Movement: Wheelchair (AT), lifting systems (WP), barrier-free public transport (UD)
- Human-machine communication: special input and control devices, e.g. using speech recognition (AT, WP)

#### > *Impaired sight*

- Movement: navigation aids (AT), guidance systems for the blind, signal units for the blind (UD)
- Human-machine communication: Enlarging software, systems for reading aloud, computer Braille lines (AT, WP)

#### > *Impaired hearing*

- Communication: Hearing aids (AT), tactile or optical signallers (WP), textualisation of information, sign language (WP, UD)

(AT: assistive technology; WP: workplace design; UD: universal design)

### *DCT for physical restrictions*

People with impaired locomotor systems can be very restricted both in their mobility and in their fine motor skills. The appropriate aids provide support to the physically disabled in extending their freedom of movement and mobility and in coping with everyday life at home and at work. In general, information and communication are increasingly being handled via electronic media, and computers are the devices that are universally employed for information processing. This means that the prerequisites for participation have changed considerably for individuals with locomotor disabilities. In most cases they have improved many times over, primarily because, for instance, the computer can usually be reached with no great effort from a wheelchair and because control units are replaceable, making it possible one to be used despite restricted arm function. While the compensation is frequently only possible – insofar as the ICT events

are computer-based – using personal technical aids, the appropriate further development of operating systems can make it possible to replace special control units, thus making the systems generally accessible. A few developments are relevant in a comprehensive way, such as in particular conceptual considerations of making the interfaces between humans and machines independent of traditional means such as keyboard and mouse and either not allowing electro-mechanical instruments to be used any more or developing interfaces that are more strongly sensory-intuitive. It has been shown, however, that the use of personal assistive technologies and even of universal design cannot adequately compensate for the described functional restrictions. In many cases, assistive technologies and universal design can only be used for their intended purpose after certain preconditions such as qualification and training have been met. In other cases, both kinds of technology cannot compensate for the functional restrictions at all. In such cases, the affected individuals require personal support in the form of assistance in performing work.

#### *DCT in sight impairment*

The blind and those with severe sight impairment are strongly restricted in their choice of profession. The digitalisation of information communication, computers, e-mail and the internet open up new options for this group of individuals in terms of social and professional participation. A personal computer and corresponding aids makes it possible for them to directly comprehend and autonomously process written documents that are available in digitalised form. The prerequisite for this is, however, that operating systems and application programs are designed without barriers. One great advantage of digitalised data is also the option of multi-channel output, e.g. via speech, in written form, or through tactile output media. The user can correspondingly tailor the output of information to his or her needs. It is, however, also clear that aids to using a computer have their limits. The key technologies for the blind and sight-impaired such as screen reader and enlargement software cannot make all the software programs at the workplace accessible; adjustment of various programs may be necessary. In practice, this means that the creation or retention of workplaces for the blind and sight-impaired can under certain circumstances be very expensive. And even if the employer is basically willing, for instance, to employ blind staff, this may not always be possible due to the programs used at the workplace.

Autonomous mobility in strange environments is the biggest problem for the blind. This problem can be (positively) influenced, in particular by designing the environment to have few barriers. Navigation systems for pedestrians that can actually be used would also facilitate orientation for the blind and severely



sight-impaired in public. The degree to which the blind can autonomously move in unknown environments by using navigation systems will depend on how reliably their location can be determined and how detailed and up-to-date the underlying maps are.

### *DCT for hearing impairment*

People with hearing impairment are subject to considerable restrictions in almost all forms of direct communication, which is, however, in most cases a central professional requirement. Even if the problems caused by a loss of hearing differ considerably, the basic point is access to spoken communication. Depending on the degree of loss of hearing, the options for and limits on compensation through the use of technologies are very different. Viewed overall, the possibilities for professional integration have improved considerably with the spread of the internet, written ICT offers based on it and the widespread use of end-devices for e-mail, internet and mobile phone text messages. Further DCT with a more general focus can be grouped together under the concept of the textualisation of information that is to accompany spoken communication. Modern speech recognition systems are capable today of turning speech into written text relatively reliably. In the future, the aim is for reliable speech recognition systems that are suitable for everyday use and integrated into common communication technology to enable parallel representation of oral speech as text. It must be noted, however, that the development of technology for the textualisation of spoken information and communication is still at a relatively early stage. In the future too, particularly those with hearing loss will be forced to rely on individual technical adjustments or personal support – ranging from special eLearning opportunities to sign language interpreters – in order to take part in working life.

Above all, taking universal design into consideration means for people with impaired hearing that ICT media are designed in such a way that they address various senses. Communication thus does not remain restricted to hearing; reading is also involved as are tactile forms of information intake. One form of generally directed DCT is the use of the appropriate technology in the design of buildings and transportation systems to support the use of a hearing aid. The textualisation of acoustic information in buildings, transportation systems and technical facilities (devices) through the use of integrated optical signals, destination indicators and electro-optical station indicators in train stations, airports and transport vehicles is now widespread. The integration of induction loop systems in buildings improves the perception of acoustic instructions via the hearing aid.



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## POTENTIAL FOR FUTURE DEVELOPMENTS

The potential of DCT in the field of work are manifold and increasingly conflict with the factors »ubiquitous computing« and »ambient intelligence«. A personal end-device creates an interface to the surrounding network, periphery and remote networks that is adapted to someone's individual needs. In this way all services, individualised in the same way, can be called up almost everywhere and flexible working structures realised. On the basis of widespread devices such as mobile telephones, applications can be realised which permit – in addition to the programmed involvement – local access to powerful computers and human support. Such systems are capable of supporting people individually and in a targeted fashion and provide the security of always being able to summon help.

The prerequisite for individual operator units is the availability of efficient in- and output. Today, such technologies are available as speech input and output, head and eye control as well as BCI (brain-computer interface) and EEG. A crucial factor is the realisation of open interfaces in electronic machines and devices that permit a smooth, secure and fast exchange of data between a machine and an (alternative) operator unit. Overall, further potential can be tapped by integrating devices and the environment. The combination of individual operator units and environmental intelligence, which is already laid out in work environments through their usually well constructed information-technical infrastructure can lead to novel barrier-free overall solutions. In particular, the programmable flexibility and «intelligence» in such systems can support individual access in each case instead of a solution which must function equally for all. This corresponds to implementation of the concept »Design for All« using modern ICT.

The field of mechatronics also offers many more approaches for DCT at the workplace. Active, powerful mechanisms can – proceeding from crane technology (facilities) on the one hand and robotics on the other – be developed into DCT. Such devices are today conceivable not only as firmly installed facilities but also as mobile person-related solutions. In addition, with the available mechatronic components, simple work-specific manipulator applications can be realised that which support people with disabilities in handling tasks. It is however still necessary to adjust the industrial components optimized for speed and precision with the aim of cooperative support for people in a shared working space.

It should be noted that the perspective that is most frequently directed to the concrete individual case should be supplemented by a preventive view of modern freedom from barriers and of design for all. The organisation and extension of structure, targeted networking, public provision and training and higher educa-



tion are key elements for future developments here. The degree to which existing DCT and future technical innovations promote social participation and as such also become relevant to the workplace depends in the end, however, on many other measures and basic conditions.

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## LEGAL FRAMEWORK CONDITIONS FOR DCT AT THE WORKPLACE

In the German Social Code (Sozialgesetzbuch) IX, «Rehabilitation and Participation of Disabled Persons» from 2001, various regulations from the areas of social and labour law relating to disability were brought together. Due to the many layers of the concept of «DCT», there are, according to the type of technology, still different legal framework conditions and responsibilities. This broad legal foundation is the basis for a system of social security benefits which is divided up into benefit sectors (prevention, healing therapy, rehabilitation and care), and differentiated into benefit areas (ranging from medical to professional rehabilitation) and the areas of competence of service and care providers.

The use of assistive technologies in Germany is mainly regulated by the various parts of the Social Code. The design of the workplace complies with the conditions of the law for the severely disabled and the Labour Protection Act with its subordinate regulations. The laws of equality for the disabled at the federal and state levels in Germany anchor the concept of universal design in German law and attempt, in the framework of their respective jurisdictions, to work towards a barrier-free design of the environment.

### *Entitlement to benefits*

Independent of the severity of a disability, everyone in Germany is entitled by social legislation to the availability of necessary DCT if in the presence or threat of a disability the restriction on the ability to work can be avoided or limited and/or participation in working life according to the person's preferences and abilities can be permanently secured. In particular assistive technologies come into this category. Which ones are relevant in the individual case and whether services are also included or not is specified in the system of social benefits in the various fields and the large number of cost bearers (e.g., the German Technical Aids Register of the health insurance companies). Since 2008, those affected can to some extent choose whether they receive assistive technology as a cash or a non-cash benefit that they use at their own responsibility (in the framework of a personal budget). The rules laid down by the individual cost bearers in the

field of social benefits are then merely a basis of assessment but otherwise not binding.

People with an officially certified severe disability, if they are employed, have a claim on their employer to a job which corresponds to their abilities, a working area equipped with assistive technologies and a place of work with disability-friendly furnishings. Independent of the presence of a disability, employees are entitled to the preventative use of DCT if health risks at the workplace can be avoided through their use.

For general DCT, particularly regarding the barrier-free design of the environment, there are a variety of regulations at the federal and state levels because of the different areas of jurisdiction and responsibilities. A benefit entitlement cannot however generally be inferred from this.

#### *Areas of jurisdiction*

In the German system of social benefits, several cost bearers (the health insurance companies, pension funds, or the Federal Labour Office) can be responsible for the actual delivery of a package of benefits in the form of DCT. Together they share a common responsibility for benefits to those affected.

The employer is responsible for barrier-free design of the workplace. This, however, only applies to employers who actually employ people with severe disabilities. Not all employers, however, are obliged to employ such people (only those companies with more than 20 workplaces), which they can moreover even avoid by paying a compensatory fee. Since enacting the Equality for the Disabled Act (BGG), the German government requires that institutions that carry out federal law realise universal design with regard to communication, construction, transport and information technology. The states have passed similar regulations to be introduced over different periods of time for institutions within their areas of jurisdiction. In addition, the BGG provides that barrier-free design should to a large extent be achieved by means of self-responsibility, with disabled associations and companies reaching target agreements.

#### *Product security*

In order to guarantee specific safety and health requirements particularly for such person-related DCT that entail a special degree of intervention in the body, uniform licensing and control procedures were explicitly laid down in the EU guidelines for medical products (in some cases similar to those for pharmaceuti-



icals). They have been incorporated into national law. Furthermore, various technical norms are intended to give a certain degree of product security, especially with reference to freedom from barriers.

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## THE MARKET FOR DCT

As a result of the legal framework, a sphere of responsibility and problem solving is developing for DCT whose complexity as a rule increases with the severity of the disability. Especially for those with severe disabilities, this creates interface problems in making assistive technologies available, above all during the transition from therapy to rehabilitation. In sum, a very special »market situation« develops that has numerous participants in structures that are strongly regimented.

*Assistive technologies* are a component in the *market for medical devices and aids* that has developed over time and in which the following groups of actors are active:

- > *Users of assistive technologies* – whose participation in society is as a rule limited because of their disabilities – who depend on specific assistive technologies and who often do not have to have to finance them and/or are not able to finance them;
- > *Cost bearers of assistive technologies* – in particular one of the German statutory health or pension insurance companies – who have different legal mandates, who have to be very responsible in handling the finances entrusted to them, and who therefore are increasingly taking cost (-benefit) aspects into account, who increasingly check these aspects in licensing procedures, and who sign service contracts with providers of assistive technologies
- > *Providers of services for assistive technologies* – hospitals, retail healthcare suppliers, etc.) – that select, install, adjust, and maintain assistive technologies for users and that inform, school, and train them
- > *Manufacturers of assistive technologies* who often develop very specific solutions for a relatively small number of users and who provide these solutions via special distribution channels.

Efforts are being made to use various measures to increase the competition in the market for medical devices and aids. Currently, the market dominance of the cost bearers has enabled them to force service providers to reduce some prices, which can be accompanied by simplification of the products and a reduction in services. The users of assistive technologies continue to have little influence over this. There is a substantial deficiency in transparency in the market place for the

users and the manufacturers of assistive technologies, both in Germany and in the EU as a whole.

Next to these structures of distribution that are controlled by the cost bearers, the market for self-payers who receive some reimbursements from cost bearers (as has been the case for seeing and hearing aids for some time) is increasingly gaining in significance for numerous assistive technologies. The developers and manufacturers of innovative DCT are increasingly also aiming at this second market. The introduction of «personal budgets» may well strengthen this trend. A good footing in information and knowhow is an important condition for those affected to be able to act as «responsible» consumers, but also for manufacturers to estimate market chances and to become more active.

Although assistive technologies that are made available as technical tools for work are not subject to the structures existing in the market for medical devices and aids, they are also characterized by limited market transparency. As the cost bearer, the employer as a rule does not possess the specific expert knowhow to determine with authority which assistive technology provides the best link to a specific place of work for which type of functional disability.

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## CONCLUSIONS AND OPTIONS FOR ACTION

The use of DCT does not automatically mean that people with a disability have better chances of being included. A sustainable impact on the opportunities for participating in working life can often only be achieved in conjunction with further factors at the level of the individual and of the surrounding environment. From the perspective of society and against the backdrop of demographic change, access to working life and keeping a place of employment constitute important key elements. These elements also have a secondary effect on those who can no longer work gainfully, encouraging them to accept a more active role, to limit their loss of autonomy and to reduce their dependence on others (e.g. caregivers). For this reason it is important that in the development of DCT a stronger focus is put on the relevance of these technologies to a place of work and that adjunctive measures be jointly further developed.

### *Applied research and development*

A limited number of people in employable age who have different functional disabilities face very diverse demands of work. The demand for assistive technologies will therefore remain fragmented and limited in the future. The demand side



alone will hardly produce the resources necessary for research and development without dedicated financing of them. A programmatic line of research «DCT for older employees» appears sensible considering the increasing number of older people who are gainfully employed.

An international comparison of research and development of current and future DCT shows that many countries focus on measures to promote structural development in addition to providing support for concrete projects. Various European countries use national centres for DCT to steer research, development and the use of DCT according to public interest. In the USA support in the area of rehabilitation technology is provided to certain rehabilitation engineering research centres for a limited period of time. Such structures supplement in a dedicated manner research conducted in industry and universities. Such centres do not exist in Germany, where there are no clear structures for research on DCT, and where research customarily takes place in industry alone or in individual university institutes and with project financing. The programmes of the European Union are concentrated on support for international joint projects (e.g. strategic targeted research projects, or STREPs, integrated projects, or IPs, and networks).

#### *Organise and implement measures in an integrated fashion*

For people with a disability and for the act of providing them with DCT, Germany's segmented system of social support creates interface problems—precisely because responsibility is divided among different bodies. Elements that are part of a social handling of disability and that are at least supposed to alleviate the interface problems include »joint responsibility«, »single source for providing service«, »appraisal by social medicine that takes working conditions into consideration« and »case management«. These factors have largely been resolved in theory and anchored in legislation on social matters (Sozialgesetze). In practice, however, they are not being optimally implemented and still offer significant room for improvement. As a consequence, a focus for future development of the social support systems in Germany is improved coordination of individual measures while taking a company's working conditions into consideration. The latter is a fundamental condition for making DCT available and for employing them effectively.

#### *Promoting structural change*

Measures to promote structural change are necessary to support innovative developments with regard to DCT. It would be sensible for there to be better networking between those active in this field (the Federal Employment Agency of

Germany, employers, unions, integration offices, self-help organizations, educational institutions, cost bearers, research institutions, providers of assistive technologies), but a national coordinating office could also taken on an important role in promoting development that meets actual needs. The inclusion of the cost bearers and practitioners can promote such a development that would also take into consideration the later financing of DCT. Strong international networking can improve the transfer of experience and the approaches for solving problems from other countries. It would be a task for such networking to actively pursue the technological potential offered by other fields of technology by transferring information from them.

#### *The Disabled: experts on their own account*

The goal of policy toward the disabled in Germany is to enable people with a disability to participate in life in society according to their own desires. The disabled are legally entitled to obtain assistive technologies. They must, however, be comprehensively informed in order to assert their claim and to make decisions according to their own will. The point is not only to continuously improve the information that is being provided, but to ensure that those affected know about the available information and are able to understand it. The feeling of self-responsibility of the disabled themselves has been significantly strengthened with regard to assistive technologies by the »personal budget« and, with regard to accessibility, by the instrument »target agreement«. Yet there are still significant discrepancies between a theoretical solution and reality. Neither the disabled nor their organizations are as a rule in a powerful enough position to act as equals toward cost bearers in negotiations and to assert their right to the available assistive technologies. Trial simplification and greater procedural transparency are urgently needed to achieve this. Coaching could help to strengthen the necessary competence in the disabled.

#### *Strengthen the position of the disabled associations*

The associations representing the disabled were given the primary responsibility of negotiating accessibility agreements with the respective managers to reorganize the public and private sphere (e.g. passenger travel and service sector) in order to achieve an accessible environment. This has produced a very differentiated sphere of action and regulation that does not offer the disabled any perspective, for example, that the minimum standards of accessibility to infrastructure realities in construction or other fields that are actually necessary will become reality. One reason – in addition to the often incomplete plans regarding accessibility – is also thought to be the current (rather weak) position of the as-

sociations. They would have to be strengthened considerably in order for them to define and demand targets in connection with an accessible reorganization of surroundings.

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## **RESUMEE: SOCIAL RESPONSIBILITY**

For many people with a disability, the use of DCT can improve their chances for participating in work. The maintenance and increasingly the better exploitation of the potential of this workforce constitute both a central element of the principle of participation as a form of social response to disability, and a necessity for society in order for it to cope with demographic changes and the labour shortage that is becoming evident. These DCT can, however, only be effective if they are flanked by specific training measures and are accompanied by strong acceptance by employers and employees.

From a high-level perspective, well-thought through use of DCT offers significant potential to make it easier or possible for individuals with a disability to participate in working life. At the same time, this facilitates social participation or makes it possible to better use and maintain the manpower of the disabled as well as to have the effect of providing socioeconomic relief. While the availability and use of DCT are often a prerequisite for this, they alone are not decisive. Additional measures are necessary to be able to create and permanently maintain employment for the disabled. Preparing a person with a disability for a specific position always requires planning and the corresponding implementation of the measures at numerous levels.

In this regard, Germany's segmented system of social support continues to exhibit significant interface problems precisely for the disabled. Overcoming these problems and constantly improving and advancing the use of DCT therefore remain an organizational task for society as a whole.



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