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"Mobility in the 21st Century:

Ensuring mobility in spite of a physical disability"

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1) Introduction

Mobility - it is defined as "the ability to move or be moved freely and easily" (English Oxford Living Dictionaries).
The emphasis in this definition is placed on the adverbs "freely" and "easily". We easily get out of bed, brush our teeth, eat breakfast and drive freely to work. But what if we are interfered in these activities? What if we cannot move freely and easily anymore or we were never even able to do so at all?
For some people technology, especially in terms of mobility in the 21st century, may mean driving a fast and high-tech car, in which a functional computer controls every single movement. But in contrast to those people, some people are dependent on technological developments in order to maintain independence due to a physical disability that restrains their mobility.
For instance, mobility cars, which are specially adapted vehicles that exactly meet their owners` needs, can be used despite of a physical disability and ensure mobility.
To be more specific, in the case of the UK, the Disability Living Allowance (DLA) provided such vehicles. The DLA had a Mobility scheme of which 65000 disabled people made use of. They could lease a new car, scooter or powered wheelchair when receiving the highest rate of the "mobility component". But in April 2013 the Personal Independence Payment (PIP), which has different demands in order to receive the high rate, replaced the DLA. Under those circumstances, only 55% of the people, who were signed for the DLA, could keep their cars. The other 45%, consisting of 13900 disabled people have lost their cars and consequently their mobility and independence. The minister of Disabled People, Justin Tomlinson, defends the decision to replace the DLA by the PIP by stating that "people's circumstances changed over time and it was right that they should be reassessed" (Nikki Fox, BBC, 2016). [2]
Even though this statement may not justify the loss of the cars of the people, it completely applies to our present situation and the need to adjust the technology in view of an ageing global population and an increase in non-communicable diseases. Accordingly, now and in the future, people will have to deal with more and more so called "mobility impairments".

2) Mobility Impairment

Mobility impairment is a subgroup of disabilities, which includes people with an upper or lower limb loss or disability, manual dexterity and disability in coordination with different organs of the body. These conditions can be congenital or they are the result of an old age, another disease just like multiple sclerosis or a heart disease or an accident. All of these people are restricted in their mobility due to a physical disability.

Just like the mentioned ones, three other diseases are major causes of mobility impairments. The first one is “Cerebral Palsy“. People suffering under this chronic and non-communicable disorder are restrained in their body movements and muscle coordination even though their muscles and nerves are completely intact and functional. The impairment is rather the consequence of a damage of one or more certain areas of the patient`s brain during fetal development or before or during or shortly after their birth. Thus, this damage or fault in the development in the motor areas of the brain significantly obstruct the brain`s ability to control the movements and the posture of the patient. Moreover, secondary conditions like muscle spasticity may occur. However, apart from therapy and training there is no specific cure for either the main conditions or the secondary ones.

The second disease to mention is the neural lube defect “Spina Bifida“ which is the result of the failure of the fetus` spine to close properly during the first month of pregnancy. That leads to an incomplete development of the brain, spinal cord and protective coverings. That means that some children are born with an open lesion on their spine, which however provokes a significant damage to the nerves and the spinal cord of the child. The opening of the spine may be surgically repaired, but the damage is permanent. On the other hand, some children can also be born without a lesion, but there is still the possibility that their spine is formed improperly or that there is a notable damage in their nerves. Nonetheless, again there is no cure for this disease.

Finally, a genetic disease that should also be referred to is “Muscular Dystrophy“. This disease generates a progressive weakness and degeneration of the patient`s skeletal or voluntary muscles just like the heart muscles, which means that it can not only affect the muscles but also the organs. In contrary to “Duchenne Muscular Dystrophy“, which concerns children, there is also “Myotonic Muscular Dystrophy“, which describes the occurrence of the disease in adult age. Again, there is no cure or in this case even no specific treatment in spite

of physical therapy and corrective orthopaedic surgery. [3]

Even though all these diseases are the result of a defective development as a fetus and are consequently caused by the body itself, it should be also beared in mind that not only diseases or an old age can result in a impaired mobility, but also accidents.
Even the smallest incidents like breaking the leg temporarily but seriously affect the patient`s mobility. They do not suffer from mobility impairments, however there are severely dependent on crutches in order to walk on their own.
The difference is that some people are dependant on products to ensure their mobility throughout life and some only temporarily.

3) Assistive Technology

As can be seen, mobility impairments can occur in different ways and because of different reasons just like diseases or serious accidents. But all those people suffering from this physical disability have in common that they all need assistive products to ensure their independence through mobility and to improve their quality of life.

Assistive technology (AT) includes products, equipment and systems used to advance working, learning and the everyday life of disabled people for whom speaking, typing, remembering, seeing, hearing and walking poses a notable obstacle that they have to face everyday. The mostly known products in the AT are wheelchairs, crutches and braces, although there is a comprehensive variety in the AT industry.
AT can be low-tech just like communication boards or high-tech like special-purpose computers, but it can also be hardware for prosthetic or computer hardware like pointing devices. Moreover there exist computer software like screen readers.
The purpose of all of them is not only to maintain, but also improve the functional capabilities of people with disabilities. [1]

3.1) Products

The immensely fast growing technology sector has a positive impact on the AT, too. Since the new developments and inventions cannot only be used to produce an extremely fast car or artificial intelligences to clean the house, but it can also be adapted to design new products for people with disabilities. That means that besides of the above mentioned more common AT products like the wheelchair and walkers, there are also some very high-tech developments. Two of the leading companies in this sector are Honda and Panasonic. They combined robotics and mind control to give people with limited mobility freedom and independence.

One of their inventions is the "Toyota Mind Control Wheelchair Prototype", which is based on a Brain Machine Interface (BMI) system to read the brain waves in order to control the wheelchair to move left, right, forward and reverse. It is ideal for example for paraplegic people, who are not able to use their hands and arms in order to put their wheelchair into motion. Some of these people are not even able to speak, but even they can move from one place to another by using this wheelchair.

Furthermore, the "Panasonic Home Bed/Wheelchair Combo" is a bed that easily transforms into a wheelchair without needing any assistance. As can be seen in the figure below it can be brought into the three positions as a bed, as a seat and as a wheelchair separated from the bed only by using a computer. Again people, who are not able to control or move their limbs and who otherwise would need a care worker that transports them from the bed into the wheelchair, can use it. Since the usual process of transportation is very demanding and unsafe for both the care worker and the patient, removing the process considerably reduces the risk of injuries.

Figure 1: "Panasonic Home Bed/Wheelchair Combo" [B]

Wheelchair adapted vans are quite known nowadays but the “Honda Freed Van“ is in comparison to the common vans much smaller and with a lower floor what makes the use of it significantly easier. Getting in and out of the car is made quicker and the van can be used in narrow places in the city that are usually avoided due to the size of the common vans. In the figure on the right hand side a ramp that is attached to the car shows how a wheelchair can be easily transported into the car.

Figure 2: “Honda Freed Van“ [A]

Figure 3: “Quickie Match Point Wheelchair“ [D]

Even doing sports is made possible by the AT through athletic wheelchairs like the “Quickie Match Point Wheelchair“ for tennis with which the owner can switch directions by switching their own weight without risking a tip over even when making the most energetic movements during a match. The material and technology for this better flexibility was originally invented for the automobile industry but could be integrated into the AT. As can be seen on the figure on the left side the wheels are positioned differently to guarantee balance and agility.

The “Porsche Design Pegasus” depicts another development of wheelchairs, which is a wheelchair that is able to fold out and bring the user up to the same level of their surrounding. Talking to standing people or getting something from the shelf that cannot be reached when sitting is now made possible.

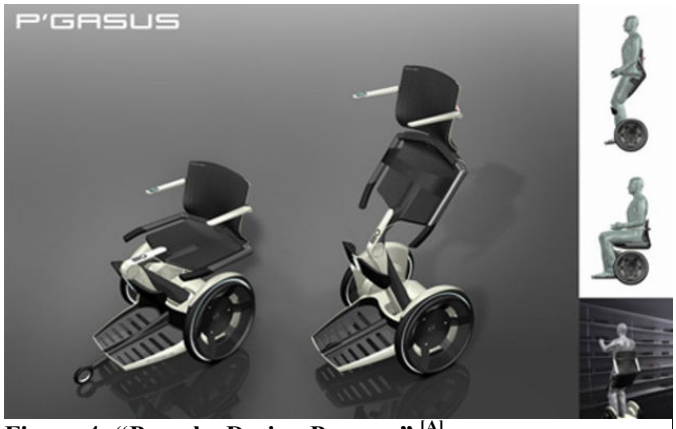

Figure 4: “Porsche Design Pegasus” [A]

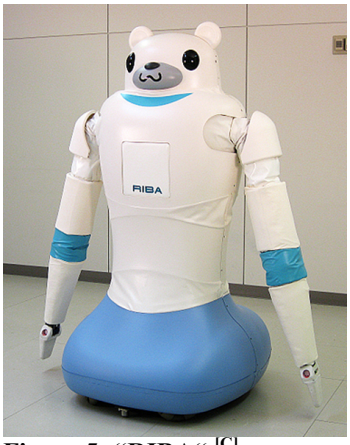

Figure 5: "RIBA" [C]

Also in other fields of the AT new and innovative products exist just like the "Robot for Interactive Body Assistance (RIBA)". This is a robot looking like a giant teddy bear that can be employed instead of a care worker to lift the patient from chairs and into their bed only using voice commands. In this case the process of transportation is not completely removed but there is no need for a care worker anymore and the design of a huge teddy bear might hearten the children or even some adults. [4]

Except of the athletic wheelchair, all products are either prototypes or only close to production. Nevertheless, they give an outlook on how the future of AT might be.

3.2) Problems

As has been noted, the AT is developing fast and generates great products for people with physical disabilities, but indeed only a minor group of the global population has access to them. In fact, today only 1 of 10 people who need those products have access to them even though by the year 2050 more than 2 billion people will need at least one assistive product and the older people even two or more. [5]

The minor access to AT is the result of high costs and a lack awareness, availability, trained personnel, policy and financing.
National AT policy or programmes are only in a few countries existent or only marginally developed. In high-income countries such programmes are mostly separated from the health and welfare scheme, therefore being provided with assistive products means coping with a long and costly process consisting of multiple appointments at different locations to which care workers have to bring the patients to. That means that not only do the patients have to pay for the product itself but also for the process of getting them only living on a health and welfare budget. In middle- and low-income countries theses programmes do not exist at all. The patients who can afford the assistive products have to purchase them directly at a pharmacy or private clinic, whereas the others who cannot afford them have to rely on donations or charity services, which mostly provide low-quality or used products that are not applicable for the patient or in need of repair and maintenance.

Additionally, assistive products are crucially dependant on qualified health personnel for proper prescription, fitting, user training and follow-ups of the product itself. If these steps are not sufficiently considered, the patient will not benefit from the product. The product may even harm the patient for instance when using a wheelchair without pressure relief cushions for people with a spinal injury. Yet, only 25 % of the low-income countries have prosthetic and orthotics training programmes and the prevalence of disability-related mobility impairment is the highest in those countries with a lack of qualified personnel in health care and AT. In other words, there is only one professional per 5000 patients available.

Equally important is that a lack of access does not only mean a lack of mobility and independence, but also a difficulty to participate in the civic life and the labour market. Consequently, people feel isolated and excluded. Moreover, the need of care workers is higher, but neither the patient nor their family can afford the therapy and help due to the lack of job possibilities and constant need of nursing and care.
An example of how integrating a person with a physical disability into society leads to socioeconomic benefits is that owning a manual wheelchair significantly rises the access to education and employment and reduces healthcare costs and needs due to the reduction in the risk of pressure sores and contractures. But still, only 5 to 15 % of the 70 million people who need wheelchairs have access to one. [6]

4) Conclusion and Outlook

To come back to the UK and its new system PIP and its consequences, it goes without saying that even in Europe where all foundations for disabling disabilities is given and the technological sector is extraordinarily encouraged and sponsored, support of the government is still the essential part of the solution for this challenge.
Young people need to be more encouraged to be trained and educated in the caring and medical sector to help those who cannot help themselves and in cases they can help themselves the government should not make it a harder challenge to get an assistive product than living without them by forcing them to participate in an endless seeming marathon of doctor`s appointments and constant validations of their disability.

Developing special products is only one part of ensuring mobility despite of a physical

disability. It should be also focused on how these people can get the existing products and not only constantly inventing new and high-tech devices that no one can even afford. Awareness and understanding seem to be the key points for a solution. People with a physical disability should be informed of the possibilities given by the AT and the access should be at least partly government-funded, since these people are mostly not even able to work.

All points considered, disabling disability is a steady process and a challenge we will probably also have to face in the future. But in comparison to the past when someone, who was not able to walk, had to spend the rest of their life in bed, technology has achieved astonishing improvements that prove that even the impossible seeming things can be invented. That is probably the one thing that denotes mobility in the 21st century. Even though we are still in the beginning of the century it can be stated that in no other century, more technological inventions and improvements of the mobility of people no matter the physical abilities could be noted.
However, instead of only trying be better and faster, we should focus more on the original purpose of technology, which is to help and support the humans.

5) Sources

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