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Proposal Of Draft For European Laws:

Set of proposals with concrete actual impact on the Economy, Environment and society

Draft Law for usage of Exoskeleton for mobility hindered individuals

Reduced mobility of individual:

Issues of current wheel chair solutions:

Current support

Current Solutions: Wheelchairs

New Solutions:

Introduction to the Proposal for use of exoskeleton

A certain portion of the population cannot enjoy all the amenities life offers. Persons with handicap, would it be mental, visual, auditive or physical are somewhat catered to in most industrialized countries, but still cannot take advantage of all situations as not-handicapped persons could. Disabilities can affect roughly 1/4 of the population. Physical handicap, or reduced mobility is one of them. It impacts approximately 13% of the population. These can origin at birth but most, in that case, are the result of illnesses, accident or simply age. The focus of this proposal is on physical handicap as new development could provide interesting solutions.

All nations have instituted rules and regulations to increase accessibilities for reduced mobility persons, mostly related to wheelchair access. These are very slowly being put in place, and mostly for public building and facilities and some private area (Hotels, shops and restaurants). The investments required to comply are significant.

Still, persons using wheelchairs, if all changes were eventually put in place would not have universal access to every areas in all circumstances (country site, littoral etc..). Furthermore, the constant sitting position engenders many other issues, physical, medical and social.

Today, new technologies and development could provide other more pertinent solutions. These solutions are the purpose of this suggestion for proposal for usage of Exoskeleton.

Summary of Base facts related to the Proposal

Reduced mobility of individual:

There are many persons with disabilities in the world. The average is roughly 1/4 of each countries population. Generally, disabilities are classified in 5 main categories:.

- mobility handicap
- Sensorial handicap (visual, Sound),
- Psychological e handicap (personality disturbances),
- Mental handicap (Intellectual deficiencies)
- Invalidating pathologies.

Mobility issues affect roughly 14 % of the population. Although the other ailments are equally cumbersome, mobility implies more structural investments. New medical and technological devices are the focus of the sensorial handicaps. For mobility, it implies structural and mechanical adaptation in addition to medical attentions.

In a typical country, like France, 5.3% of the population has reduced mobility or 3.5 millions of the population. These come in many forms, but roughly 500,000 (0.8% of population) would be using wheelchairs. It is estimated that 77,900 persons are paraplegic.

Issues of current wheel chair solutions:

Reduced mobility is a major hindrance for daily work and social life. Wheelchair users are even more affected for various reasons. The imposed sitting position is the main culprit for many issues for the users. For some sufferers these can be dramatic, leading to pathologies like:

- Pressure ulcers
- Impaired breathing
- Functional limitation
- Secondary musculoskeletal conditions

But there are many more prevalent issues difficult to prevent, resulting from the usage of wheelchairs:

- Weight Gain
- Diabetes
- Pressure sores
- Bone and Joint Pain
- Cardiovascular Diseases

These are the basic most common additional health issues, but the hindrances to daily life are more numerous when one is bound to the use of a wheelchair. Below in the appendice, an association listed 23 social problems for wheelchair users which we do not notice, ranging for little annoying issues like filthy hands, to turning into narrow spaces (like bathrooms), or accessing public transportation, arguing with people on parking spaces.

Some more obvious issues include; travelling on uneven terrain (even on streets); no access to older building with narrow corridors, when not stairs; access to public transportation, even when rarely available; Some unseeable gaps are tricky or difficult to pass; cramps and sores; attitude of the general population. However, the most difficult social interaction is the constant view of the world from a lower point, making interaction with others more difficult.

In addition to these, wheelchair users are bound to have various therapies to alleviate some ailments, such as physiotherapy, ergo-therapy, handling of sores, sports, re-education of sphincter or intestinal tracts.

Current support

Laws and regulation

Laws have been set around the world to enforce support to disabilities, and particularly regarding mobility impaired individuals.

In the US, laws such as the Federal Americans with Disabilities Act and the Federal Fair Housing Act and similar state and local laws ensure people with mobility disabilities are able to access goods, services, programs, and housing. The ADA requires property owners and operators to provide ramps in many situations.

For example, in the Ramp Requirements: A ramp to be usable by people with disabilities, ramps must generally be built to certain specifications. Unless one of a few limited exceptions apply, the ADA requires that business and government buildings built for first occupancy after January 26, 1992 and first occupied after January 26, 1993 be accessible to people with mobility disabilities.

These laws tend to be similar in most developed countries.

Many transportation providers, such as taxi and bus companies, are required to provide people with mobility disabilities access to their services. This often means providing a ramp or lift to enable entry to some of the vehicles in their fleet. Local governments across the developed world, such as cities or counties, are often required to provide small ramps called curb cuts to allow people with disabilities to access sidewalks.

Despite the numerous requirements and regulations across the boards, only new construction are complying. Difference vary widely by country. A crying, although common example is the Paris Metro. Only 9 of the 303 (3%) metro stations in the French Capital city provide access to persons with reduced mobility. Further, all these are on one newer automated line (Number 14). The*APF France Handicap* adds that Paris is a poor example, newer Metro lines in other cities are better with 18% in London, 82% in Barcelona, and 88% in Tokyo. The point being that even the newest systems do not provide universal access.

Economic impact

The EU Member States spent over €280 billion of social protection expenditure on disability benefits in 2014. This represented 7.3% of the total spent on social benefits, a rate almost equivalent to that spent on survivor's benefits (5.7%) and family benefits (8.6%). Since 2010, the share of social protection expenditure on disability benefits in the European Union (EU) has remained stable.

Across Europe, the share of expenditure on disability is highest in Denmark, and lowest in Cyprus. It accounted for more than 10% of total social benefits in Denmark (12.9%), Croatia (12.2%), Sweden (12.0%), Estonia (11.8%), Luxembourg (11.4%) and Finland (10.9%), but for less than 4% in Cyprus (3.2%) and Malta (3.7%), followed by Italy (5.9%), Ireland and the United Kingdom (both 6.0%).

People with disabilities in 10 countries face large extra costs of living. These costs can range widely, from an estimated US$1,170 to $6,952 per year. In a developing country such as Vietnam, for example, the estimate stands at $595 for additional health costs alone.

Current technologies

Wheelchairs

Wheelchairs is the most common solution for mobility impaired persons. The more severe the handicaps the more costly the device. Devices usually range from $2000 all the way to $15000.

The more advanced the technology that goes into the wheel chair is, the more significant the cost.

Other solutions

Wheelchairs are not the only solution for mobility impaired persons. Actually, solutions to enhance mobility have existed for a long time.

Exoskeletons exist since numerous decades. In recent years, development in mechanics, batteries, and to some extent artificialIntelligence have given a boot to the industry. Although the industry began in the 1980s with US military-funded prototypes, most powered suits were too clunky, impossibly expensive, and years ahead of any viable market. By 2012, however, the technology had caught up with engineers' imaginations (and budgets). Mobile computing, processing speeds, batteries, sensors made powered suits smaller and cheaper, but applications for $200,000 walking skeletons were still limited, primarily for medical rehabilitation.

Today, many of the 36 or so exoskeleton companies such as EKSO Bionic or SuitX are beginning to offer lightweight passive designs using metal and carbon-fiber frames that attach to the body or exterior scaffolding for construction and logistics workers. For Example, SuitX released its own modular system, a passive exoskeleton for the legs, backs and shoulders, each of which is listed for sale for under $5,000, as well as a more expensive full-body version for workers in industrial settings who need support for a wider range of movements. Its Phoenix X, an experimental powered version, allows paraplegics to walk unassisted for four hours up to 1.1 miles per hour. SuitX $40,000 Robotic Exoskeleton lets the paralyzed walk. Still pricier than motorized wheelchairs, SuitX's Phoenix exoskeleton weighs just 27 pounds and is custom-fit to the user's body.

SuitX is just one of the companies hoping to boost interest in exoskeleton research. Competing suits like the ReWalk, which costs $70,000 and weighs about 50 pounds, are striving to reduce costs while improving functionality. If exoskeleton makers can drive suit costs down to a few thousand dollars, they could start competing with motorized wheelchairs.

Even though relatively few exo-suits exist, the list of potential users is long and growing. Beyond the many disabled and elderly people who could make use of the technology, so too could their nurses and caregivers, with health insurance covering the bill. In addition, shipping and industrial workers, loggers and miners would benefit from job-assist exosuits and robotic wearables, perhaps with employers writing off the costs as a safety device. Meanwhile, governments could soon start outfitting fire-fighters, EMS, and disaster personnel, combat troops and logistics specialists with protective exoskeletons

The market is growing fast after years relying on military and medical insurance companies. ABI expects to see that the market for exoskeletons exceed a billion dollars within the decade, up from about $100 million last year. "Lower body exoskeletons for rehabilitation or as quality-of-life enablers are available today,". Systems that augment or amplify on-the-job performance are next.

Although limited power supply is still a huge constraint, today's batteries may prove to be enough as exosuit tech morphs into new forms. Not only are passive exoskeletons arriving on the wearable robotics catwalk, but many new exoskeletons have gone soft, eschewing metal frames altogether for flexible fabric and artificial muscles. The new trend stems from a DARPA-funded program which seeks to prevent damage to injury-prone areas of the body and minimize fatigue.

For paraplegic and tetraplegic users, more advances are being made rapidly. They go all the way to have implanted or exterior sensors on the brain to guide the robotic exoskeleton. These latest developments are custom made, one time prototype costs $200,000. The bar for a full set exoskeleton for paraplegic usage is $40,000 as the SuitX example above. These are still one time custom made products. As industries usage grows, it will increase demand tremendously,. We can expect that sophisticated exoskeletons could quickly reach the costs of a wheelchairs.

Summary of Objectives to reach:

There are two competitive objectives for the treatment of help for the mobility impaired individuals. First, society must provide basic access to the society for impaired persons, providing care and minimizing hindrances for social integration. The second to minimize the issues on the economy reducing specialized related costs and investments.

In order to reach the first objective, society must search for the best solutions. Currently the most used solution is to provide a wheelchair. This solution results in other negative impacts for the users. On the one side, it leads to new pathologies for the users engender mostly from the sitting position. Second, the wheelchair solution provides some limitations with regards to social inclusion and interaction, on one side to the universal access to the world, and on the other side to the sitting position and all the issues it implies.

To fulfill the second objective, government or institutions must implement reasonable solution at a minimal costs. With the choice made above, usage of wheelchairs, it implies major comprehensive structural changes to all necessary accesses for wheelchair bound citizens. This access is supposed to be mandatory to reach public buildings, transport, shops and restaurants. It must be noted that access any rough terrain is not included. As mentioned, in some examples above and below, only a fraction of the required changes are in place. Legislations force new buildings to include wheelchair access, but it will take decades until the required changes are made to existing buildings not yet complying. One reason is that the costs are prohibitive. The example of the underground metro in Paris is significant and typical.

A concrete example would be to take small town of 10,000 inhabitants. It would have between 100 to 200 shops. Typically, halves of these would be compliant with regulation (A good average).

the others must have to invest between 10,000 and 50,000 euro to be in par with basic requirements for mobility access. This would mean a required investment of a minimum of 500,000 Euro (50 shops x 10,000 Euro) to 5 million Euro (100 shops x 50,000 Euro). Either way this is quite conservative, as many other entities (restaurants, hotels, transports) would require such changes, and changes can reach 100,000. Conservatively we can estimate that to comply, a small city would need to invest roughly between 5 to 10 million. That said, it still does not give universal access, to wheelchair users.

With 10,000 inhabitants and a 0.8% average reduced mobility residents using wheelchairs that would be 80 persons. If everyone would be provided with a full exoskeleton at today's price that would be 3.2 million Euro. Of course the funds required would be much lower. First not all 80 persons would require a full exoskeleton. Only 14 of them (national Average) would require this level of sophistication (euro 560,000). Furthermore, it is expected that the costs would fall from 2,000 to 5,000 Euro (160,000 to 400,000 for the entire 80 persons population).

In summary, both objectives would be reach.

1. The health of the users of exoskeleton would be improved by a routine standing position.
2. The economic aspect would bring tremendous savings to the society with savings of 4 or 5 million Euro for a small town and that is worst cases

The objectives would be greatly exceeded, as the users would now have universal access to all sites, even old and difficult ones. This would give a tremendous new perspective to persons with disabilities who would even be more "mobile" than other persons (enhanced strength etc…)

One additional advantage is the creation of a new industry to build assemble or maintain exoskeletons. The first country stepping in would have the advantage. It must be noted that these will come in any case. Investing in wheelchair access, is a losing proposition. It is very costly and is just lip service to solving universal access for persons with reduced mobility.

Lastly, once the industry and the usage is booming, solution for the aging population is foreseeable, enhancing livelihood of the aging population.

Law proposal

In order to reach the above objectives, the current focus on wheelchair usage and access is a losing battle, as it is extremely expensive and will never permit universal access to all persons with

disabilities. Furthermore, wheelchair solutions are combined with many other issues would it be medical and social. In all cases, persons with reduced mobility found their chances more limited than the rest of the population.
The new technology of exoskeleton is very rapidly expanding and improving. Costs currently range from 100,000 to 40,000 for paraplegic usage. It is foreseen for the prices to drop to between 2,000 and 5,000 Euro. At that time, it would be compatible in price to sophisticated wheelchairs. This usage would solve many medical issues but could give equal baring to all users, as compared to persons with no mobility issues.

Therefore, this proposes a law to modify requirements for investment for access for mobility reduced persons. A city could choose to either enforce compliance for mobility access, or opt to invest and provide its citizens with appropriate Exoskeletons.

In order to help and support this transition, and mostly the first city (or country) supporting this trend, a support fund must be made available. In addition, a national team of experts should be set to establish rules and goals for usage and support implementation.

As implementation can only be stepwise, it might be useful for the city which choses this path to establish a “rental” exoskeleton for visitors.

APPENDICES

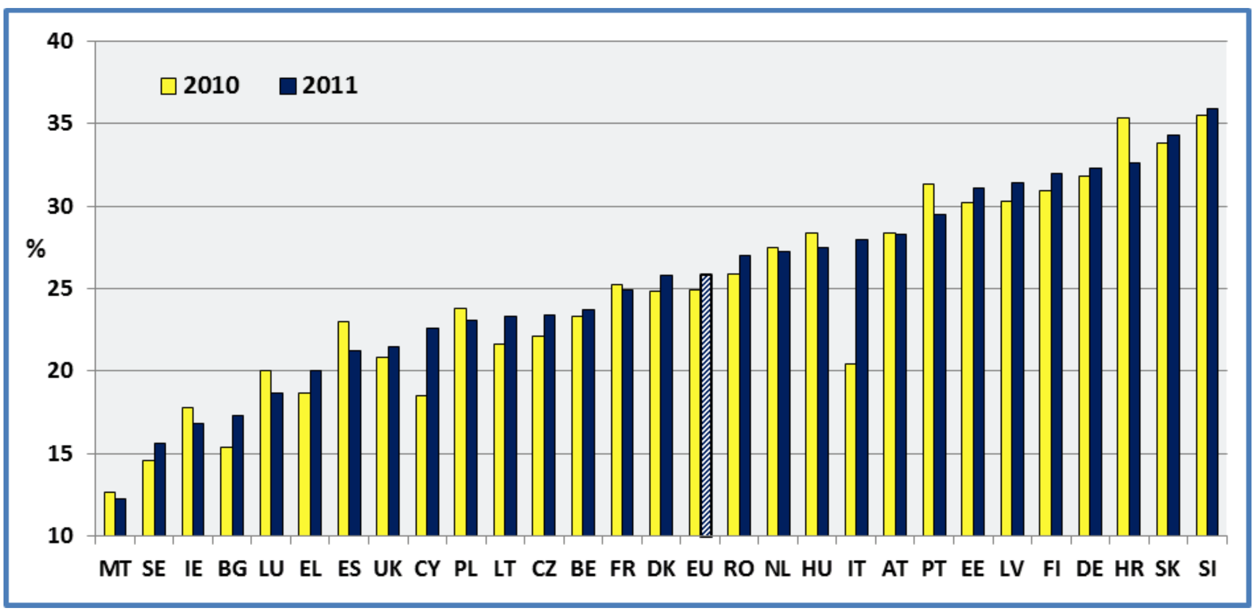
Base facts related to the Proposal

Reduced mobility of individual:

In 2011, about 26% of persons aged 16 and over declared an activity limitation. In comparison to 2010, there is an increase of about one percentage point. However, the EU-SILC definition does not take into account any "interactions with barriers". The prevalence rate ranges from 12% (Malta) to 36% (Slovenia).
About 28% of women aged 16 and over declare an activity limitation compared to 23% of men of the same age group.
About 8% of persons aged 16 and over declare a severe disability (strongly limited) and about 18% declare a moderate disability.

Europe 2020 objective requires that 75 % of the population aged 20-64 should be employed.
At the EU level, about 47% of persons with disabilities are employed compared to 72% of persons without disabilities. The EU average is 67%. The employment gap is about 25 percentage points (26 percentage points in 2010). The national employment rates of people with disabilities range from 20% (Croatia) to 59% (Sweden). We may note that countries

Figure 1: Percent of people with disabilities by Member State; 2010 and 2011



As a % of the same age group; age: 16+
At the EU level, about 8,3% of persons aged 16 and over declare a severe disability (strongly limited).
About 17,5% declare a moderate disability. The variability of percentage covering severe disability across Member States is smaller compared to the variation of moderate disability prevalence across Member States.

There are 5 main categories of Handicap.

- mobility handicap
- Sensorial handicap (visual, Sound),
- Psychological e handicap (personality disturbances),
- Mental handicap (Intellectual deficiencies)
- Invalidating pathologies.

CDC estimates that 26% of Americans have some form of disabilities, roughly 1 in 4 person (61 million). That can be broken in the following categories

- Self Care 3.7%
- Vision : 4.6%
- Hearing: 5.9%
- Independent living: 6.8%
- Cognition: 10.8%
- Mobility: 13.7%

This matches roughly the same similar study in France from the INSEE:

- 13,4% of French have mobility deficiencies
- 11,4% Sensorial deficiencies (partial or complete (Visual and Auditive)
- 9,8% suffer for organical deficiencies (linked to vital organs),
- 6,6% intellectual and mental deficiencies ,
- 2 to 3% of the population uses Wheelchairs.

These disabilities get worse over time but can fluctuate.
Multiple Sclerosis – neurological deterioration
Muscular Dystrophy – muscular disorders
Chronic Arthritis – inflammation of the joints

AS exemple, approximately 12 millions of French (Over 66 million citizens) are affected by a handicap, with 1.5 million visual deficiencies and 850,000 with reduced mobility. 9.6 millions is the number of personnes administratively recognized as having a handicap for at least 6 months and meeting significant difficulties in their daily activities.

Other more general evaluations estimate that 3.5 millions or 5.3% of the population have reduced mobility. Of these between 650,000 and 370,000 (depending on sources) are using wheelchairs.

The spinal cord injuries affect nearly 30 000 persons in France, with 50% under 25 years old. Infirmité
The number of persons classified and supported by the National medical insurance for paraplegia in France in 2016 was 77,900 of which

- 3,400 < 14 years
- 12,100 < 34 years
- 24700 Between 35 and 54 years
- 15,400 Between 55 and 65 years

- 12,700 Between 65 and 74 years
- 9,600 over 75 years

Issues of current wheel chair solutions:

There are many problems linked with the use of wheelchairs.

Just the sitting causes issues. Following spinal cord injury or disease (SCI/D), improper positioning in a wheelchair ***will*** cause serious problems:

- Pressure ulcers
- Impaired breathing
- Functional limitation
- Secondary musculoskeletal conditions

But there are many more prevalent issues difficult to prevent, resulting from the usage of wheelchairs

Weight gain: Although many manual wheelchair users gain upper-body strength, other wheelchair users become more sedentary because of the nature of their injury. If you have a spinal cord injury, it's likely that the muscle mass below your injury has decreased, and the fat has increased. Your metabolism has slowed, and it's much easier to put on weight. Weight gain, however, can make it harder to move and increase joint pain and the likelihood of developing pressure sores. Talk with your health-care professional about an eating plan that will help you avoid weight gain.
Diabetes: If you put on weight — or become obese — your likelihood of developing diabetes rises dramatically. This is partly because the way your body processes insulin has changed. Your injury might mask some of the symptoms, such as increased thirst and excessive urination. It's important to see your doctor regularly for blood-insulin testing, and if you do develop diabetes, follow your doctor's instructions to the letter.
Bone and joint pain: Manual wheelchair users are susceptible to shoulder pain, rotator-cuff injury and stress on their extremities. Muscle tightness can develop in front of the shoulders, and opposing muscles can become longer and weaker. Work with your physical therapist to avoid these problems.
Pressure sores: Loss of muscle tone and diminished circulation can cause pressure sores to develop.
Cardiovascular disease: Wheelchair users who are overweight are at an increased risk of developing heart problems. Again, a healthy eating plan is essential.

In addition, wheelchair users are subject to many more common daily issues, such as the list of 23 annoyance below:

1. Having filthy hands all the time
2. Getting our clothes caught in everything.
3. Sustaining mysterious injuries on a daily basis
4. Having to do a 10-point turn to get out of any public bathroom

5. And never being able to see ourselves in the mirror.
6. Having to tweeze hairs out of our caster wheels
7. Realising that public transport doesn't cater to them at all
8. And buses aren't any easier. They are constantly waiting to find out whether the wheelchair ramp actually works
9. And they are always faced with the decision of whether they should give up the space on the bus for a pram.
10. Trying to fit a wheelchair into a car.
11. Not to mention the fact that the cars are always filthy.
12. And they're covered in scratches too.
13. Having to confront people who wrongly park in disabled parking spaces.
14. And getting dirty looks whenever *they* pull into wheelchair parking spaces.
15. People staring when they are doing really boring things, like getting petrol.
16. Being patient when the people you love mess up.
17. Having to reassure people that we are OK all the damn time.
18. Dealing silly questions like "Do you have a job?"
19. Especially the ones about sex.
20. Having to shout for attention so they are heard at bars.
21. Being massively screwed every time the lift in the building breaks.
22. Being constantly nervous that the wheelchair is going to tip over.
23. Trying to let people know that they are more than just spokes 'n' wheels.

1. Accessibility To Doctor's Offices and Clinics
Due to barriers, individuals with disabilities are less likely to get routine preventative medical care than people without disabilities. Not only is accessibility legally required, it is important medically so minor problems can be detected and treated before turning into major and possibly life-threatening problems.
2. Public Transportation Barriers
These barriers are found in buildings, the physical space around and between buildings and in the virtual environment. To correct these issues would include eliminating obstacles in the built environment, enabling access to public transportation, eliminating obstacles within public vehicles and making it easy to board and disembark, as well as making information and communication services suitable for use by all. The key is to integrate architectural, planning and transport measures throughout and across the entire mobility system.

Here are another list of the typical daily challenges faced by wheelchair users:
1. Older buildings with small doorways or corridors. Most parking lots are very difficult to maneuver through. Simple things like shopping, visiting friends or relatives become a really difficult and complex task very quickly.
2. Uneven and rough terrain especially with sloping ground make moving manual wheelchairs almost impossible.
3. Public transit. Getting on and off a bus that is equipped with wheelchair equipment can be tedious and time consuming and that is for the ones that do have the equipment. It will be

impossible otherwise. Accessing different levels of the transit system especially if there are no elevators or if they are not working.

4. You might easily walk over the gap getting on a train or sub way but for a wheelchair user crossing that gap can be very tricky and there is always the fear of getting your wheels stuck!

5. Wheelchair users don't have a choice but to sit which can present the problems of muscle cramps and pressure sores. Either affliction can be a great source of discomfort.

6. Since wheelchair are below the normal or expected line of vision, motorist, pedestrians and other road users can present a danger if they don't see the wheelchair user quick enough to react. This almost blind spot has caused many accidents involving wheelchair on the street and sidewalks.

7. The last and probably the biggest challenge is the attitude of society to wheelchair users. Those without physical disabilities might find it difficult to see through the eyes of a wheelchair user. Some typical reactions to wheelchair users include being talked down to, being totally ignored or thinking that the wheelchair user can do more for him or herself.

Wheelchair users must often follow strict and contant thérapies, such as:

- Physiotherapy to maintain articulations and muscles. This is often done with "standing positions
- Ergo-therapy to learn daily normal movement, for dressing, eating, washing
- Do some sport or physical activities
- Re-education Vesico sphincter linked to the injuries but complicated by the sitting position.
- Re-education intestinal
- Prevention sores from the sitting position

Current support

Laws and regulation

Laws such as the Federal Americans with Disabilities Act and the Federal Fair Housing Act and similar state and local laws ensure people with mobility disabilities are able to access goods, services, programs, and housing. The premise behind those laws is that people with disabilities should be able to participate in community life just like everyone else. One way that the ADA and similar laws make sure people with mobility disabilities can access goods, services, and programs is by requiring property owners and operators to provide ramps in many situations.

Ramp Requirements

For example, in the Ramp Requirements: A ramp is a sloped device that connects one flat surface to another flat surface across a vertical distance. In order to be usable by people with disabilities, ramps must generally be built to certain specifications. Unless one of a few limited exceptions apply, the ADA requires that business and government buildings built for first occupancy after January 26, 1992 and first occupied after January 26, 1993 be accessible to people with mobility disabilities. That means, in part, that those buildings must have accessible entrances that are either level with the street or reachable by a ramp instead of by climbing stairs. The FHA has similar requirements for the entrances of "covered multifamily dwellings" designed and constructed for first occupancy after March 13, 1991.

Owners and operators of buildings that were constructed after the ADA and FHA new construction dates discussed above may still have to provide ramps if it is feasible for them to do so. The ADA requires preexisting buildings (those constructed prior to the dates above) to have ramps if it is "readily achievable" for the owner to install them.
In addition, many transportation providers, such as taxi and bus companies, are required to provide people with mobility disabilities access to their services. This often means providing a ramp or lift to enable entry to some of the vehicles in their fleet.
Local governments across the developed world, such as cities or counties, are often required to provide small ramps called curb cuts to allow people with disabilities to access sidewalks.

Despite the numerous requirements and regulations across the boards, only new construction are complying. A crying although common is the Paris Metro. Only 9 of the 303 (3%) metro stations in the French Capital city provides access to persons with reduced mobility. Further, all these are on one same line (Number 14) The*APF France Handicap* adds that Paris is a poor example, newer Metro lines in other cities are better with 18% in London, 82% in Barcelona, and 88% in Tokyo. The point being that even the newest systems do not provide universal access.

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People with disabilities in 10 countries face large extra costs of living. These costs can range widely, from an estimated US$1,170 to $6,952 per year. In a developing country such as Vietnam, for example, the estimate stands at $595 for additional health costs alone.

Current Solutions: Wheelchairs

Like you'd expect, very few people actually think about chairs until they need one. This can often cause a huge strain on someone who has been through a very unfortunate event and now has to rely on an external device for mobility. More severe handicaps require power wheelchairs which cost even more money. These devices usually range from $2000 all the way to $15000.
The more advanced the technology that goes into the wheel chair is, the more significant the cost is. It is important to understand your specific needs before purchasing a chair because it provides a more accurate price bracket for you to consider when purchasing.

New Solutions:

Exoskeletons exist since numerous decades. In recent years, development in mechanics, batteries, and to some extent artificialIntelligence have given a boot to the industry. Below are a few example, not a thorough research on currently available skeleton.

Although the industry began in the 1980s with US military-funded prototypes, most powered suits were too clunky, impossibly expensive, and years ahead of any viable market. By 2012, however, the technology had caught up with engineers' imaginations (and budgets). Mobile computing, processing speeds, batteries, sensors made powered suits smaller and cheaper, but applications for $200,000 walking skeletons were still limited, primarily for medical rehabilitation.

Today, many of the 36 or so exoskeleton companies such as EKSO Bionic or SuitX are beginning to offer lightweight passive designs using metal and carbon-fiber frames that attach to the body or exterior scaffolding for construction and logistics workers.

SuitX released its own modular system, a passive exoskeleton for the legs, backs and shoulders, each of which is listed for sale for under $5,000, as well as a more expensive full-body version for workers in industrial settings who need support for a wider range of movements. Its Phoenix X, an experimental powered version, allows paraplegics to walk unassisted for four hours up to 1.1 miles per hour

The market is finally growing as well after years relying on military and medical insurance companies. "The big trend now is moving into the commercial space," says Dan Kara of ABI Research. ABI expects to see that the market for exoskeletons exceed a billion dollars within the decade, up from about $100 million last year. Although just a sliver of the market today, ABI expects the construction, manufacturing, demolition and logistics industries to represent almost half the industry revenue within eight years.

SuitX $40,000 Robotic Exoskeleton lets the paralyzed walk. Still pricier than motorized wheelchairs, SuitX's Phoenix exoskeleton weighs just 27 pounds and is custom-fit to the user's body. Paralyzed from the waist down after a BMX accident, Steven Sanchez rolled into SuitX's Berkeley, California, office in a wheelchair. A half-hour later he was standing and walking thanks to the Phoenix—a robotic exoskeleton now available for around $40,000. The suit returns movement to wearers' hips and knees with small motors attached to standard orthotics. Wearers can control the movement of each leg and walk at up to 1.1 miles per hour by pushing buttons integrated into a pair of crutches.
SuitX is just one of the companies hoping to boost interest in exoskeleton research. Competing suits like the ReWalk, which costs $70,000 and weighs about 50 pounds, are striving to reduce costs while improving functionality. If exoskeleton makers can drive suit costs down to a few thousand dollars, they could start competing with motorized wheelchairs.

Even though relatively few exosuits exist, the list of potential users is long and growing. Beyond the many disabled and elderly people who could make use of the technology, so too could their nurses and caregivers, with health insurance covering the bill. In addition, shipping and industrial workers, loggers and miners would benefit from job-assist exosuits and robotic wearables, perhaps with employers writing off the costs as a safety device. Meanwhile, governments could soon start outfitting fire-fighters, EMS, and disaster personnel, combat troops and logistics specialists with protective exoskeletons

Cheaper, more capable exoskeletons are on the way, according to Dan Kara, veteran robotics industry analyst at ABI research "An entire wearable robotics industry, today comprising around forty R&D groups worldwide, is coalescing that should become a $2-billion global market by 2025."

"Lower body exoskeletons for rehabilitation or as quality-of-life enablers are available today," he says, but systems that augment or amplify on-the-job performance are next. "This means assisting with industrial tasks that require heavy lifting, or easing extended standing, squatting, bending, or walking in manufacturing facilities and in the construction and farming industries."

Overexertion by workers costs employers $15 billion a year in compensation, so providing protective exosuits could make good business sense.

SuitX has a new workplace exoskeleton, the MAX, which is crafted to a be passive, unpowered part of Kazerooni's "design simplification" approach. A lightweight metal frame redirects loads to the attachment points on the body, transferring the strain to the hips and then down to the ground. When a wearer bends forward, compressed-air springs in the back to take some of the load off, almost like shock absorbers in a car. The shoulder unit employs a similar assist-mechanism for lifting or working above the head.

Although limited power supply is still a huge constraint, today's batteries may prove to be enough as exosuit tech morphs into new forms. Not only are passive exoskeletons arriving on the wearable robotics catwalk, but many new exoskeletons have gone soft, eschewing metal frames altogether for flexible fabric and artificial muscles. The new trend stems from a DARPA-funded program which seeks to prevent damage to injury-prone areas of the body and minimize fatigue

Dutch Exoskeleton Solution by Laevo focuses on: The Aging Population Of Japan