OUTPUT 5

Market analysis to show economic profit for better rehabilitation & higher independence

	Partner responsible	Dead-Line (date due)	Date when it was realised
Redaction of the deliverable	PP5 - Voka – Kamer van Koophandel Oost-Vlaanderen	31/01/2021	27/12/2020
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Introduction

Mobility solutions for people with disabilities and aging people have sharply evolved in recent years in particular with the introduction on the market of connected devices, lighter batteries and better battery life, power add on and assistive technologies. The EDUCAT project aims to develop and test new assistive technologies for power wheelchair and assess the benefits in terms of mobility and quality of life for people with disabilities and their carers.

The aim of this document is to derive the market potential of these assistive technologies for power wheelchair with a focus on the Belgian and French markets.

Belgium and France are countries in which the market potential for wheelchairs is large due to an ageing population and the further development of home care for people with disabilities. Although these two countries are neighbours and share a common language (for the Walloon region), important differences can be found in the health insurance financing scheme for wheelchair usage that need to be taken into account when considering market access. The French market strongly depends on the reimbursement rate by the National health insurance and thus the price is a major criterion for purchase. In Belgium, on the other hand, reimbursement rate is higher in comparison to France for both manual and power wheelchair.

Whereas needs and willingness to have assistive technologies are clearly expressed the way to acquire these technologies slightly differs from one country to another one.

This document elaborated in the frame of the EDUCAT project gives deep insights of the wheelchair market needs and potential for assistive technologies for people with disabilities

1. Acquiring a wheelchair

.1.1 Overview of the actors involved in the wheelchair equipment decision

1.1.1 Process of acquiring a power wheelchair

Getting a power wheelchair can be a long process, requiring many steps and involving different actors from the medical decision to the acquisition of the equipment and to its financing.

Once the diagnosis has been made by a physician, it can take depending on the country up to a year and a half between the medical prescription and delivery:

Physician, Physical and Rehabilitation Medicine (PRM) (the only professional, authorized to prescribe power wheelchairs): medical diagnosis for obtaining a medical prescription for a wheelchair.

Obtaining an appointment with a physical and rehabilitation doctor can also be time-consuming.

Occupational therapist and/or physiotherapist: to assess the suitability of the proposed wheelchairs for the patient's needs and abilities.

Following the examination, they provide a certificate to people who are capable of using their future wheelchair. They can also adapt the wheelchair to the person, adding or adjusting equipment (headrest, anti-bedsore cushion, footrest, harness, etc.).

And they evaluate the impact of disorders on daily life, in the street, etc. The wheelchair must accompany the person, and not generate new pathologies.

Point of sale (pharmacies, wheelchair specialist companies, medical equipment distribution companies, etc.): to obtain quotes and to test the wheelchair.

At the time of delivery, almost all distributors carry out the installation and adjustment of the equipment. They check the equipment and provide a detailed invoice. The vast majority also give instructions for the correct use of the equipment and help in financing procedures.

Also, the rental of power wheelchairs is exceptional.

1.1.2 Information, advice and support organisations

a. At the local/ provincial level

People can obtain information on home automation or mobility solutions, get advice on financing from different institutional and structured actors:

- Functional re-education centres (CRFs) and physical medicine and rehabilitation centres and specialists: health establishments that receive disabled persons who need to regain the use of some of their functional abilities.

- social healthcare institutions

- Aging and disability networks; made up of local and national organizations working to support older adults and people with disabilities. Some organizations focus on a particular type of disability, age group, or type of service, whereas others have a more comprehensive mission.

- Association of users, carer and/or relatives of people with disabilities

1.1.3 Steps to seek funding for the purchase of a wheelchair

The acquisition of a power wheelchair can require depending on the country a long process and implies different non-exclusive actors.

- Health insurance: coverage of part of the purchase or rental of a wheelchair (with a medical prescription) as well as delivery, maintenance, repair and renewal costs.

Health insurance can also provide exceptional assistance.

- Private health insurance: for main or additional financial support

- Local, provincial funds or agency: process of the applications for mobility aids and manage dedicated funds

- Insurance: The power wheelchair is considered as a "land motor vehicle". It is therefore necessary to be insured for motor vehicle liability.

1.2 Overview of the market for mobility solutions for people with disabilities

1.2.1 Manufacturers

The market of wheelchair and more commonly speaking of mobility aids is dominated by major and international companies like Invacare, Sunrise, Otto Bock, or Meyra and small and highly specialised structures in niche markets (Table 1).

Power Wheelchair Company Descriptions 2018	
Patricia Industries / Permobile	Permobil is a SEK 4 billion company with presence in 70 countries and with 1 600 employees. Owned by Investor AB through Patricia Industries, Permobil is one of their core investments. The company has grown consistently each year over the last 20 years, and more than doubled in revenue since the acquisition by Investor in 2013.
Invacare	Leading manufacturer and distributor in its markets for medical equipment used in non-acute care settings. Recovering from FDA consent decree that negatively affected net sales. Executing a multi-year transformation to shift to strategy of selling non acute care products with higher margins.
Sunrise Medical / Handicare	Sunrise Medical is a world leader in the development, design, manufacture and distribution of manual and powered wheelchairs, mobility scooters and both standard and customized seating and positioning systems.
Pride	Jazzy® Power Chairs has an electric wheelchair to fit the users. The lineup of Jazzy motorized wheelchairs includes heavy-duty power wheelchairs that are engineered for superior performance. The Jazzy® Elite HD electric wheelchair is equipped with front-wheel drive for outstanding indoor maneuvering, reliability and durability.
Graham Field	Graham-Field offers a wide array of over 50,000 items used in hospitals, extended care facilities, clinics and for people being cared for at home.
Otto Bock	Products have undergone testing involving the highest quality standards at some of the world's leading hospitals and universities.
Shoprider - Pihsiang Machinery	Shoprider products are sold throughout the United States by an established network of high quality DME/HME providers. Providers are chosen carefully to ensure that customers who buy products obtain a high level of service commensurate with the quality of products.
Merits Health	Merits organized the most professional R&D teams and most advanced & precise equipments in this industry. Quality has become the key guarantee to satisfy customers globally.
Drive DeVilbiss Healthcare	Carries a complete line of durable medical equipment including mobility products, beds, bariatric products, wheelchairs, sleep surfaces and pressure prevention products, respiratory equipment, CPAP products, self-assist products, power wheelchairs, power scooters, rehabilitation products, pediatric products, patient room equipment, personal care products and electrotherapy devices.
Meyra Group	Meyra Group is a leading designer, manufacturer and wholesaler of mobility and non invasive orthotic products. Our companies are located in few countries of Europe.
Dane Technologies / Levo Whill	FDA approved power assist wheelchair drive device, making patient transport WHILL is focused on implementing Autonomous Drive System in airports to address the significant inefficiencies of the passenger transport. Moving passangers autonomously reduces operating expenses for facilities.
Other	Power wheelchairs are a necessity with the aging of the population.

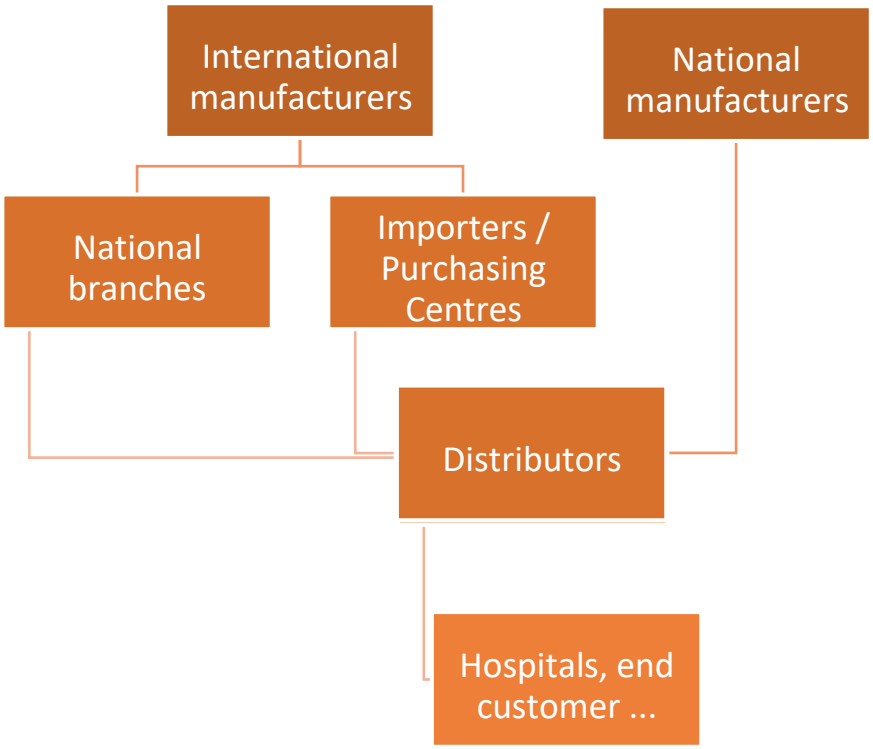
Table 1 : Main manufacturers of wheelchairs

Source: Power Wheelchairs and Personal Mobility Market Shares, Market Strategies, and Market Forecasts, 2019 to 2025 », WinterGreen Research, Inc. , Lexington, Massachusetts, 2019.

1.2.2 Distributors

The distribution channels are composed of very different structures in terms of activity and size: pharmacies, wheelchair companies, medical equipment distribution companies, etc.

Figure 1: Coordinated distribution channels of wheelchair



3 main types of structures distribute wheelchairs. They target different clients whom have needs from basic ones to the most specific and thus offer range of wheelchair accordingly.

Table 2: Main types of distributors

	Structure types	**Offers**	**Request types**
Pharmacies	Pharmacies	Basic manual wheelchairs for rent or sale	Accident resulting in temporary loss of autonomy
Wheelchair specialist companies	SME, highly specialized knowhow	Often specialising in high-end wheelchairs	Very specific, for situations of significant loss of autonomy
Medical equipment distribution company	Medium or large companies, established at regional or national level	Various medical aids including wheelchairs	Mid-range wheelchairs for all types of pathologies

The power wheelchair segment of the medical equipment market is highly competitive. We note significant competition from well-established manufacturers and distributors. Competitors have used price-cutting strategies in an effort to gain market share.
The power wheelchair segment has rapidly changing technology and technology positioning.

1.2.3 Structures specialized in home automation and disability

Home automation is the set of technologies that allow to control elements of the house, remotely. Home automation can bring greater autonomy and a better quality of life.

- ***Adaptation of housing or "intelligent" house*** (examples: JIB startup, Sunrise Medical, Fibaro etc.):
  an increasing number of household goods are becoming intelligent, they can be controlled remotely to facilitate the autonomy of the person.
- **Intelligent wheelchairs**: these innovations would make it easier to move around in restricted environments. Most of these solutions are still in the R&D phase or have initiated their commercialisation without reimbursement by national health insurance.
  Example:
  - Connected Wheelchair, by astrophysicist Stephen Hawking and Intel: a wheelchair with the ability to steer itself autonomously and to analyse in real time the medical data of its user and alert a doctor in case of emergency.
  - Neuromoov (ESME Sudria): with the ability to move with brain waves - in R&D phase.
  - Hands-free wheelchair driving by head control (Munevo) ○ Power add-on solutions for manual wheelchairs to enable them to move on challenging zones (Autonomad)

1.2.4 Sellers of spare parts

The cheapest solution to buying a power wheelchair is to supplement its original equipment with accessories and spare parts that will improve the wheelchair.
These spare parts and accessories range among: headrest supports and headrests, headrest inserts, hand rests, footrests, joysticks, power add-on, cushions...
Many structures sell spare parts, especially on the Internet.

1.2.5 Conforming material

European standards NF EN 12183 (§ 7.4) and 12184 (§ 8.3) specify that any manufacturer must indicate that his wheelchair can be used by a person (of 22 kg and over) and that he has subjected it to crash tests in accordance with ISO 7176-19 and ISO 10542 standards.
People shall check with the manufacturer or distributor that the wheelchair model has passed the crash tests front in the "direction of travel" position in accordance with ISO 7176-19.

1.3 The importance of equipping people with disabilities and the cost of nonequipment

1.3.1 Major positive impacts for people…

Power wheelchairs are needed by people with a variety of mobility impairments but also those who can encounter major problems, fatigue or pain during long trips.

The wheelchair has a positive impact on the life of the user:
The use of a power wheelchair has a positive psychosocial impact on the majority of users in terms of improved self-esteem, perceived ability, and adaptability to everyday life:

- Users are less dependent on other people and that affected their lives and personal wellbeing, as well as their family relationships.

- Users have solid reasons to use power wheelchair for independent mobility, such as attending school, working, moving about independently in the home, or being able to reach usual destinations important for the person's life (shops, bank, church, post office, medical facility, etc.) - The wheelchairs improved their self-esteem and control over their daily lives.
- Obviously, a decrease in difficulty means that the device has been beneficial.

1.3.2 … and on social costs

Significant savings - evaluated by cost analysis instrument–SCAI (Siva Cost Analysis Instrument)

SCAI focuses primarily on the additional social costs of individual programmes : the sum of all resources spent by all actors involved (hence the term social) as a consequence of the decision to adopt one specific programme rather than another (hence the term additional). If a client is prescribed a cheap pushchair rather than an expensive power wheelchair, he will incur different purchase and maintenance costs[1].

The provision of a power wheelchair seems to lead to remarkable savings, in addition to producing fairly good outcomes in terms of user satisfaction and psychosocial impact.
The purchase price of a power wheelchair is not a meaningful or even the most significant indicator of the cost of an intervention. A more meaningful indicator is additional social cost : the difference between the social cost of the intervention (the sum of all of the human, material, and financial costs, the service providers, the municipality, etc.) and the social cost of non-intervention (the cost that would have been incurred if no power wheelchair had been provided, the cost of personal assistance to push a manual wheelchair).

Moreover, the investment related to the provision and operation of the power wheelchair allows to significant savings in social costs over a 5-year period in most cases : the average social cost of wheelchair provision was about 30% of that which would have been sustained if the wheelchair had not been provided. The power wheelchair decreases the cost of personal assistance. Indeed, users would have needed much more caregiver assistance if they kept the same lifestyle with just a manual wheelchair (Table 3).

Table 3. Average additional social cost.

Average social cost over 5 years	Of intervention (79 respondents; €)	Of non-intervention (68 respondents; €)	Additional social cost
Purchase cost	5,151	—	
Residual value	−1,008	—	
Operating cost	293	—	
Services cost	16	—	
Cost of human assistance (valuated €10/hour)	11,271	53,549	
Total	15,722	53,549	−36.124

Source : Claudia Salatino, Renzo Andrich, R. M. Converti & M. Saruggia (2016), An observational study of power wheelchair provision in Italy, Assistive Technology, 28:1, 41-52

[1] Renzo Andrich & Antonio Caracciolo (2007) Analysing the cost of individual assistive technology programmes, Disability and Rehabilitation: Assistive Technology, 2:4, 207-234

In conclusion:

- Most individual programmes not only bring about positive changes in life quality, but also lead to considerable savings in terms of social cost
- Investments usually indicate severe situations requiring complex solutions with little room for alternatives
- High savings usually indicate situations that, in principle, might be solved in a different manner, but have been solved very efficiently – in terms of social cost – thanks to assistive technology.

However, the individual contexts of the implemented devices differ one from the other.

2. Focus on two neighbouring but different markets: Belgium and FranceMarket demand in Belgium

There is **no official registry** for people with handicap in Belgium. Consequently, it is difficult to find exact figures of people with disability that require power wheelchairs. We have defined **several strategies** (or combination of some) that can be followed to derive a **proxy** for the amount of power wheelchair users in Belgium:

1) **Survey data:** existing survey data with respect to disability in Belgium
2) **Belgian healthcare data**: analyzing governmental data
3) **Data other countries:** based on assumption reflecting this data to Belgian context.

2.1.1 Survey data

The largest survey, the **SEE2001**[2] with 3 475 000 respondents aged between 15 and 64, provides the most reliable data. Table 4 gives an **overview** of some findings of this study, combined with assumptions in order to derive the total amount of power wheelchair users.[3]

Within this study, **0.4% of the working population** (15-65 years) mention to have severe functional disabilities and are **chairbound**. Taking into account total population size (6.828.651), this means that 29.830 persons between 15-65 year are chairbound. In order to make an estimate on the amount of **power wheelchair users**, we have to make assumptions with respect to the share of manual wheelchairs and electronic wheelchairs. In table 4, we make the assumption that **25%** of all chairbound individuals have a power wheelchair, which leads to a total of 7.457 power wheelchair users in this age group.

For the **age group 0-14 and 65+,** we do not have a percentage that are chairbound and additional assumptions have to be made. The percentage chairbound of these age groups are based on the 0.4% of the 15-65 year group. For this population group, we know that 2.6% (0.4%/15.2%) of the individuals with functional limitations are chairbound.

We assume that this share is the same for the age group between 0-14 year, and is four times as high for the elderly (10%). Given these assumptions, we arrive at a percentage chairbound of 0.13% (2.6%*5.1%) and 4.01 % (10%*41%) for respectively the 0-14 years and 65+ group. Assuming the

[2] https://statbel.fgov.be/nl/over-statbel/wat-doen-we/volkstellingen-census/census-publicaties [3] Figures are adjusted for 2019 population

same manual vs. electronic wheelchair ratio (75%/25%), we arrive at **628 and 16.331 power wheelchair** users for respectively the 0-14 years and 65+ group.

To summarize, taking into account the findings of SEE2001 and the assumptions made, **the total amount of power wheelchair** users in 2019 equals **24.416.**

Table 4: Deriving amount of power wheelchair users, based on SEE2001

Age group	#total population	% functional limitations	% chairbound	#chairbound	#Power wheelchair users
0-14	1.805.090	5,1%	0,13%	2.514	628
15-65	6.828.651	15,2%	0,4%	29.830	7457
65+	1.629.073	41%	4.01%	65.325	16.331
Total	**10.263.314**				**24.416**

2.1.2 Belgian healthcare data

A second strategy that can be followed to estimate the amount of power wheelchair users is to look at national/regional healthcare data. Not much information is found on a Belgian level, but some interesting information is found for the Flemish region.

In table 5, an overview is given of the total amount of request for **additional reimbursement** for electronic wheelchairs for 2004-2007. At that time, reimbursement for wheelchairs was on **federal level** (RIZIV/INAMI),

but **additional Flemish reimbursement** could be requested if the federal reimbursement did not cover 100% of the total cost. Based on this information and some **additional assumptions**, an estimate of the total amount of power wheelchair users can be derived.

Table 5: Amount of request for additional reimbursement electronic wheelchairs in Flanders

	2004	2005	2006	2007	**Total**
#requests	477	365	478	349	**1.669**

The **following assumptions** are made:

- The **renewal period** for power wheelchairs is set at **4 years**
- Demographic population shares are used to estimate the amount for Brussels (9%) and Wallonia (32%). Hence, 1669/1-((0.09+0.32))=2928 new power wheelchairs in Belgium.
- The federal reimbursement is sufficient (i.e. full coverage) for 10% of all requests and 80% ask for additional Flemish reimbursement. Hence, the total amount of power wheelchairs in Belgium in one specific year equals 2928/0.10=**29.280**

2.1.3 Data other countries

The last strategy is to look at other countries for which there is data available on the total amount of wheelchair users. In this example, we looked at Germany.

For Germany, official statistics show that 6.600.000 citizens have a severe handicap and that 1.560.000 are wheelchair users. Assuming that 25% of them have a power wheelchair, we arrive at a total estimate of 390.000 German power wheelchair users. Applying the same ratios as in Germany to the Belgian context, a **total of 50.908 power wheelchairs** is obtained.

Table6: Deriving amount of power wheelchair users, based on German data

	Germany	Belgium	Information
#inhabitants	83.000.000	11.000.000	
#Severe handicap	6.600.000[4]	885.366	Statistische Bundesamt (Destatis)
Wheelchair users	1.560.000	203.634	Rollnetzwerk
25-75 % ele-man	390.000	50.908	Assumption

2.1.4 Summary market demand

Given the lack of official data in Belgian with respect to wheelchair users, the reasoning above tried to make an estimation of this amount, by combining different sources and assumptions. It is expected that the amount of power wheelchair users in Belgium lies between 24.416 and 50.908.

[4] https://archive.fo/20130710120835/http://www.rollinetzwerk.net/modules.php?op=modload&name=Sections&file=index&req=vi ewarticle&artid=106&page=1

2.2 Market supply

An important distinction must be made between the **producers** and **vendors/dealers** of power wheelchairs. As shown in market research from **Blauw Research (2010)**, approximately 10 distinct producers are identified for the **Dutch market**, see figure below. **Handicare**, **Permobil** and **Invacare** are the three largest producers from which Dutch dealers buy power wheelchairs. Blauw Research (2010) contacted **51 Dutch dealers** for this research.[3]

[3] For Belgium specifically, no general overview of wheelchair producers are found. In addition to the list provided by Blauw Research (2010), Orthopedie Van Haesendonck, Matton Orthopedie, Orthopedic, Leunen Orthopedie, Axamed and Arplama Group are other vendors/dealers in Belgium.

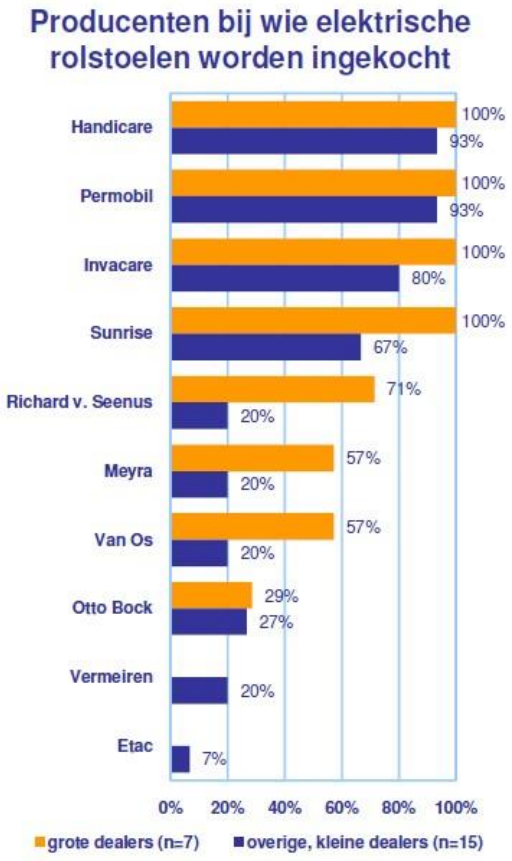


Figure 1: Producers PWC for Dutch dealers (2010, Blauw Research)

2.3 Financing of PWC in Belgium

Since 1 January 2019, the mobility equipment management is no longer organized by the national institute for health and disability insurance (RIZIV) but by **the federal states** (Flemish region, Walloon region and Brussels) and the **German-speaking community**. Reimbursement occurs through **health care insurances**, but funds such as the social integration fund for people with disabilities or funds for accidents at work. Despite the differences between the regions in Belgium, **reimbursement procedures remain similar and comparable between the organisations.**

In general, every citizen who needs a mobility aid must have **a medical prescription** from a physician. and/or a **wheelchair advice team**. Wheelchair providers can assist in finding the right wheelchair for every user. Electronic wheelchairs are separated in **four groups dependent on their usage**:

- Indoor
- Outdoor
- Inside and outside
- Wheelchairs for children.

In each category, there is at **least one wheelchair which is completely refunded** including certain supplements regarding safety, positioning and steering/propulsion. More expensive products or

versions of a certain category, as well as a**dditional costs** for more advanced tools or adjustments for which the user is not eligible must be (partially) paid by the user. The fixed reimbursement amount for a wheelchair is approximately

- 5 300 euro (indoor)
- 6 400 euro (in- and outdoor)
- 9 500 euro (outdoor)
- 7 100 euro (children)

The amounts **vary slightl**y (± 100 euro) between the communities. Supplements which must be paid by the patient range from 10-100 EUR (mainly safety), 100-1000 EUR (mainly positioning) to 6.000 EUR (mainly steering/propulsion).

The **renewal term is set at 4 years** for users below the age of 65 and 6 years for users from the age of 65 onwards. The renting of electronic wheelchairs is not possible.

The following sections provide more detail about the responsible agencies within the communities and officially recognized vendors in these regions.

2.3.1 Flemish region

In Flanders, the health insurance funds (“zorgkassen”) handle the processing of applications for mobility aids and the Flemish Social Protection Agency (“Agentschap Vlaamse Sociale Bescherming”) is responsible for the mobility aid policy and the financing and management of the healthcare funds.

The agency provides a list with refundable wheelchairs.

http://www.vlaamsesocialebescherming.be/sites/default/files/atoms/files/MOHM%20Producten_20190212.pdf
http://www.vlaamsesocialebescherming.be/sites/default/files/atoms/files/Tegemoetkomingen%20voor%20mobiliteit shulpmiddelen%20per%20prestatiecode.pdf

Currently, there is no official list of vendors available for Flanders. However, a search for vendors via “de sociale kaart” indicates a lot of vendors for Flanders and Brussels.

https://www.desocialekaart.be/zoek?who=elektrische%20rolstoel
http://www.vlaamsesocialebescherming.be/verstrekkers-van-mobiliteitshulpmiddelen-bandagisten

2.3.2 Walloon region[4]

Within the region, AViQ is taking over the financing of mobility aid benefits and adaptations. The agency still works close to the example of the RIZIV.

https://www.riziv.fgov.be/fr/professionnels/sante/bandagistes/Pages/aides-mobilite.aspx

2.3.3 German-speaking community[5]

The department of Self-Determined Life (“Dienstelle für Selbstbestimmtes Leben”) is responsible for all requests for mobility aids. It provides a detailed description of the reimbursement procedure

[4] https://www.aviq.be/handicap/
[5] :https://selbstbestimmt.be/mobilitaetshilfe.html

https://selbstbestimmt.be/pdf/Buch-der-Regelungen.pdf and a list of officially recognized vendors in the region (https://selbstbestimmt.be/pdf/Liste-Leistungserbringer.pdf).

2.3.4 Brussels

In Brussels, Iriscare has been authorized for mobility aids and Brussels insurance institutions provide the partial or full refund of the electronic wheelchair. Detailed descriptions can be found online.

https://www.iriscare.brussels/nl/professionals/personen-met-een-beperking/tegemoetkoming-voormobiliteitshulpmiddelen/

https://www.inami.fgov.be/SiteCollectionDocuments/nomenclatuurart28_8_20141001_01.pdf

3. The wheelchair market in France

3.1 Market demand

3.1.1 A dynamic wheelchair market

The market was valued € 166 million in 2001 and 290 million euros in 2013 according to the last official data[6]. This increase of the demand of wheelchair is driven in particular by an ageing population, the rise of pathological disorders and the development of home care

3.1.2 Number of wheelchair users

About 13% of French people have a motor disability: about 8 million persons in France with a motor disability. 2 to 3% of French people uses a wheelchair[9]: about 2 million persons in wheelchairs (manual or power) at home

3.1.3 The criteria for choosing a wheelchair

Main criteria to be considered when choosing a wheelchair are:

- The pathology of the patient and its evolution
- The morphology of the patient (weight, height, ...), the patient's environment
- Activities of daily life (professional and leisure)

3.1.4 Sales of wheelchairs

The aging of the population, difficulty mobility due to various pathologies, the development of home care increases the demand for wheelchairs. According to the latest studies, around 160,000 wheelchairs are sold each year.

[6] « Zoom sur le marché des fauteuils roulants
», Xerfi [9] INSEE

We note a continuing increase in volume of the market of wheelchair since the early 2000'.

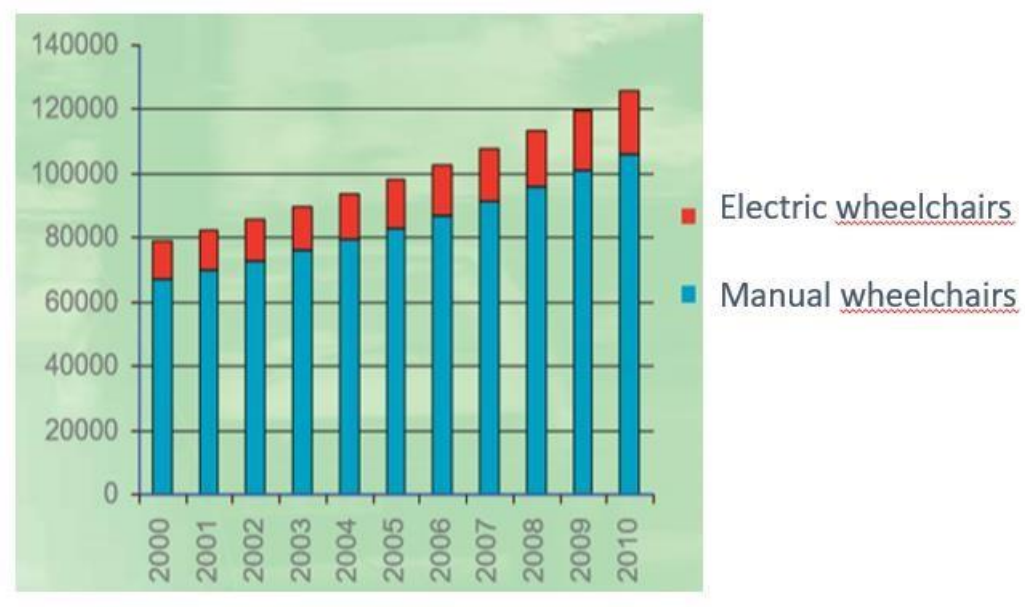


Figure 3 : « Le marché français des fauteuils roulants (Eurasanté 09/20007)

The manual wheelchair market grew by 9% between 2002 and 2006:

Table 7: Evolution of sales of manual wheelchairs from 2002 to 2006[7]

	2002	2003	2004	2005	2006
TOTAL Manual wheelchair	68 645	69 860	71 290	73 050	74 995

The wheelchair market also grew by 9% between 2002 and 2006:

Table 8: Evolution of sales of electric wheelchairs from 2002 to 2006

	2002	2003	2004	2005	2006
TOTAL Electric Wheelchair	7 955	8,115	8,300	8,495	8,710

3.2 A wheelchair market essentially "manual"

The manual wheelchairs represent the very large part of the market with more than 9 wheelchair sold out of ten (91% of volume sales). These sales are then strongly driven by dependent elderly persons for whom it represents a possibility of mobility with a carer.

[7] Ineum consulting, extrait de l'enquête pour la CNSA sur le marché français des fauteuils roulants

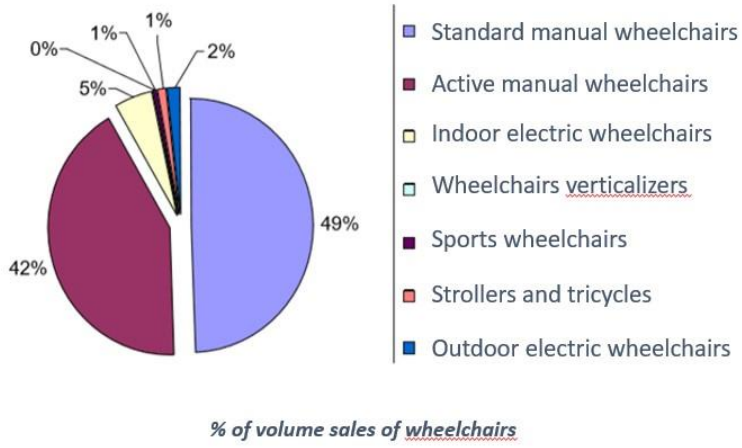


Figure 4: Le marché français des fauteuils roulants, 2006-2007, Ineum Consulting pour la CNSA

3.3 Market supply

3.3.1 France, an import market

About 90 medical manufacturers produce specific wheelchairs, parts of it or some customization. But the market is highly concentrated in the hands of major international groups such as Invacare or Otto Bock.

Invacare is the leader of the market. The American group represent the largest wheelchair offering on the market with its compatriot Sunrise Medical. Other international groups such as the German Otto Bock and the Belgians Vermeiren and Van Os Medical are also based in France with distribution subsidiaries.

The French wheelchair market is essentially an import market. It is a very competitive market where the price is the main criteria for purchase.

However, some French SMEs design and manufacture wheelchairs like Autonomad Mobility, Drive DeVilbiss Healthcare France (ex Dupont Médical) and Rupiani: they subcontract often manufacturing abroad and assemble their products in France (for attractive prices and production in accordance with European and French standards).

3.3.2 Distribution

There is a low concentration of the distribution market. Thus, the 3 main distributors make around 30% of the French wheelchair market. We can say that there are around a thousand other distributors even if 20 of them make the most of the balance.

These structures are diverse in terms of activity and size: pharmacies, wheelchair companies and medical equipment distribution companies.

3.4 Financing of a wheelchair in France

3.4.1 General

The purchase of a wheelchair can be partly or fully covered by health insurance with the following requirements fulfilled:

- Upon presentation of a medical prescription specifying the category of the wheelchair
- If the wheelchair is listed on the List of Products and Services (LPP)covered by the National health insurance
- If the user has a private insurance

Summary of Health Insurance reimbursements by material

Table 9: National Health Insurance reimbursement level by type of wheelchair

Type of wheelchair	Reimbursement LPP
Manual wheelchair	395 to 603 €
Power wheelchair	2700 to 3 938 €

With major budget constraints, the Health Insurance seeks to reduce health expenses. Therefore, the reimbursement rate can appear somehow low for some equipment.

Moreover, innovations and options are not included in the reimbursement process that can be considered an obstacle to the purchase of innovative wheelchair models.

Reimbursement rate and spending trends

The number of wheelchairs reimbursed by Health Insurance rose to more than 91,000 in 2013, an increase of 1.5% compared to one year before

80 million euros reimbursed in 2005 by the Health Insurance[8]

However, we observe a control of health spending and a restructuring of reimbursement process for wheelchairs.

Until now, the Health Insurance reimbursed 600 euros for all models of manual wheelchairs. Now, only certain models of wheelchairs remain eligible for reimbursement as Health Insurance is more and more strict.

Therefore, there is a real risk of default choices. In fact, if wheelchairs that are suitable for people are not reimbursed by the Health Insurance, people may choose a wheelchair that is still reimbursed by the Health Insurance but that does not suit them completely. Choosing a wheelchair by default can have serious health consequences if it is not adapted.

[8] Ineum consulting

In 2013, the percentage of reimbursement of cost for a manual wheelchair by Health Insurance was of 83% on average. For power wheelchairs, the reimbursement was of 68% on average.

However, these figures do not reflect reality. Many options and accessories are not supported and are not registered by Health Insurance.

3.4.2 Other sources of funding

Wheelchairs are not fully covered by Health Insurance. Other sources of funding exist to complete the financing.

Financing structure

Table 10: Reimbursement of a wheelchair

National Health Insurance	Maximum amount for a manual wheelchair: 603 € Maximum amount for a power wheelchair: 3 938 €
The general council (MDPH)	The Disability Compensation Benefit (called PCH: Prestation de compensation du handicap) This aid completes in part the reimbursement of the Health Insurance Characteristics: The user must make a request Decision: 3 to 18 months after the request. Amount of the reimbursement is variable
Complementary financing (Health Insurance and General Council – MDPH)	Extra Funds - from Health Insurance Disability Compensation Fund - from MDPH The amounts are very variable. This aid is decided on a case-by-case basis and depends on the timing of the request.
Supplementary insurance, mutual, other	Supplement on the rest of cost

Differences in the reimbursement of a manual or an power wheelchair

Reimbursements of Manual wheelchairs:

The purchase cost of manual wheelchairs is partly covered by the National Health Insurance and thus can be completed by the Disability Compensation Benefit.

Reimbursements of power wheelchair:

The difference between the purchase price and the reimbursement is important for power wheelchairs (including verticalizers). However, the charge of power wheelchairs has been reduced by the contribution of the Disability Compensation Benefit.

The average amount of the charge for the patient

The cost supported by the patient grows with the technicality necessary to take care of the handicap.

In France, about 150,000 people renew their wheelchair each year, so they have to take charge of 4,000 euros on average.

Moreover, a study of the AFM-Telethon, conducted on 477 purchases of power wheelchairs, gives us more details. In the study, the average cost of wheelchairs appears to be 23,000€ with:

- 57% is financed by Health Insurance and the Disability Compensation Benefit (MDPH)
- 19% by Extra fund (Health Insurance) and Disability Compensation Funds (MDPH)
- 16% by the complementary, mutual, associations, etc. However, all patients do not benefit from these aids.

Considering these financial supports, people still have to pay 1,850€ on average to acquire their power wheelchair.

3.5 Wheelchair rental

Rental is possible for manual wheelchairs, but exceptional for power wheelchairs.

Renting is an increasingly used solution. It allows the user to have the opportunity to change equipment regularly.

For manual wheelchairs, the List of reimbursable Products and Services (called LPP for Liste des Produits et des Prestations remboursables) provides for a weekly rental without any charges

Figure 5: Le marché français des fauteuils roulants, 20006-2007, Ineum Consulting pour la CNSA

The system promotes the rental of manual wheelchairs for less than one year. Indeed, for long term rentals, the “LPP” tariff tends to decrease significantly (from 16.45 to 10.12 €).

4. Market needs and potential for assistive technologies for power wheelchairs

4.1 A Survey based on 72 respondents from 5 countries

A survey has been sent to multiple persons in Belgium, Canada, France, United Kingdom and Caribish Nederland, for which 72 replied. The purpose of this analysis is to assess the market potential of driving assistance technologies for wheelchairs. A multidisciplinary team has been developing a prototype of a driving assistance system (similar to the parking assistance for a car) used with semi-autonomous navigation functions. The system is built onto a commercially available PWC. Using sensors mounted on the chair, the system can help wheelchair users to avoid obstacles that could not be avoided or seen. It can help users to drive safely through doorways or elevators or in crowded environments.

The majority of the respondents were healthcare professionals for 44%, other types of people for 18% and members of the association of disabled people for 13%. The other category is described below in Figure 66.

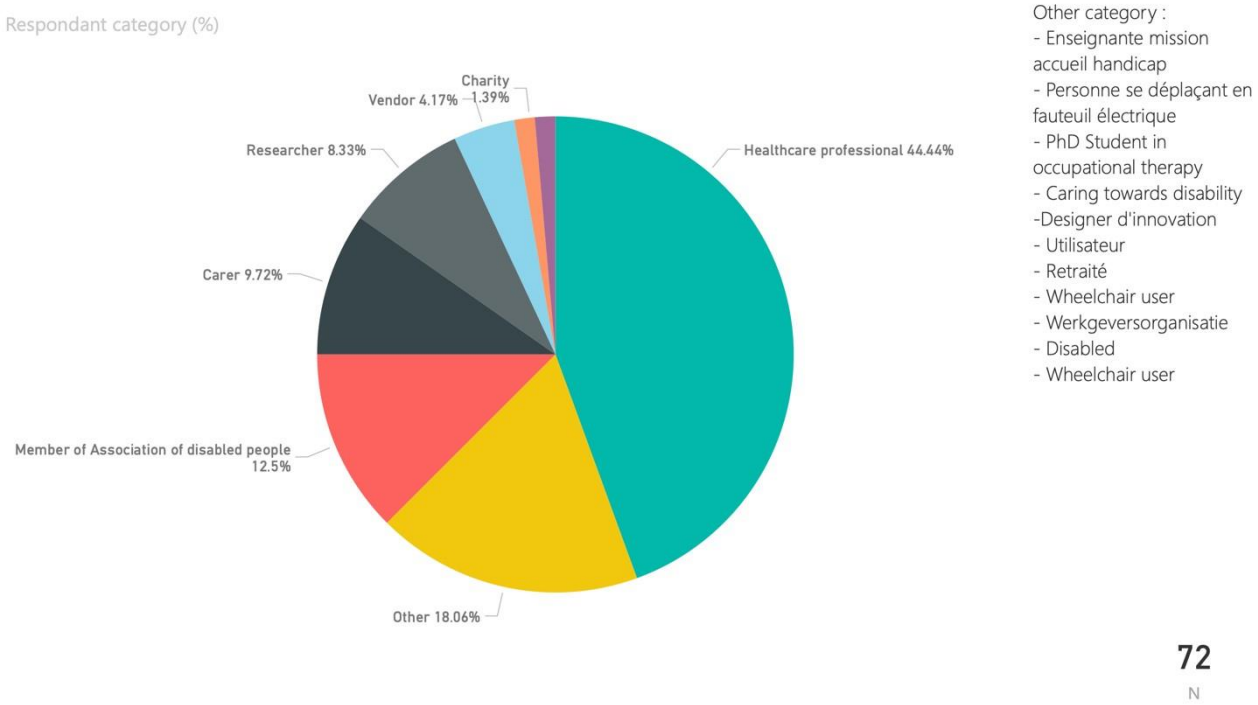


Figure 6: Respondent category, N=72 (%)

Among the respondents, 26% were wheelchair users with mobility and physical impairments for 95% of them. The majority of them could participate in the choice of their wheelchair, which represents 42%. Others could suggest a list of appropriate actions for 26% or give some advice for 16% (Figure 7). Also, when looking at the type of wheelchair used, 53% use a power wheelchair, while 16% use a manual one. The other people are using a combination of manual and power (Figure).

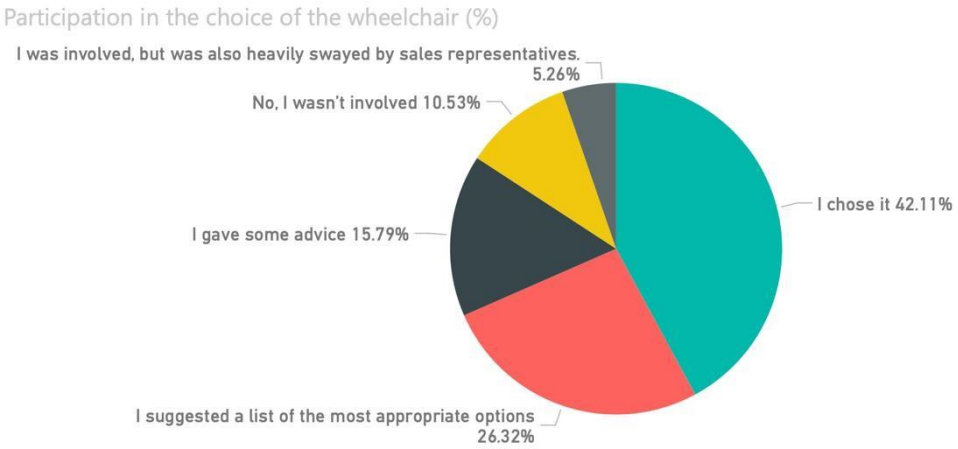


Figure 7: Participation in the choice of the wheelchair, N=72 (%)

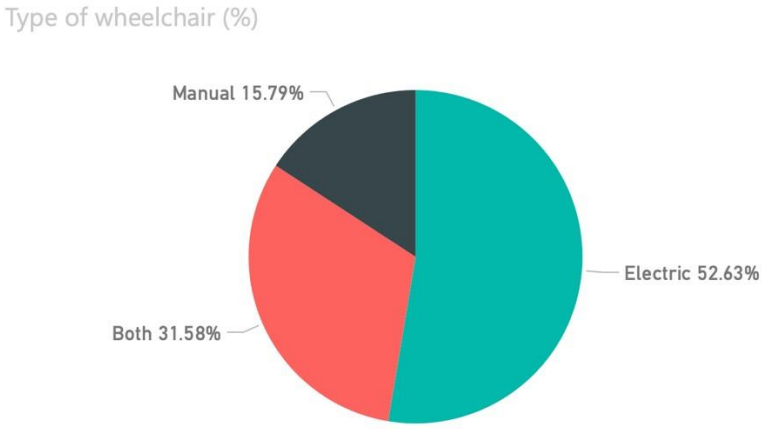


Figure 8: Type of wheelchair, N=72 (%)

4.2 Main results on issues and needs for technology

4.2.1 Environment

As it can be challenging to evolve in some environment, the survey evaluates whether wheelchair users might need help or not, in which conditions and in which type of surroundings. It shows that 58% need assistance to operate their wheelchair, especially in challenging environments, when they are tired or feeling unwell. It is noticeable that the persons answering they do not need help at all are using power wheelchairs. The latter represents 26%.

When comparing different places, it is highlighted that wheelchair users are feeling very confident in a kitchen (42%), a living room (58%) and in a park (42%). Additionally, they are feeling quite confident in an elevator (53%), a shopping centre (53%), a restaurant (42%) and in a street (43%). On the contrary, they are not feeling confident at all when they encounter cobblestones (42%), when their driving wheel loses contact with the surface (47%), when they enter and exit public transports (42%), when there are gravel surfaces (42%) and when there are potholes in the pavement (58%).

Another series of questions focused on whether in those same places, the respondents estimated at which level wheelchair users need help. When looking only at wheelchair users' answers, it showed that the places requiring a lot of help are an elevator (58%), a restaurant (53%), a shopping centre (42%), in public transportation (58%), in the street (47%), when the driving wheel loses contact with the surface (47%), when they enter or exit public transports (47%), in a crowd (53%), when encountering kerbs (42%) and when facing steep hills and slopes (47%). Additionally, they require some help on gravel surfaces (53%) or in fields (42%) (Figure 9).

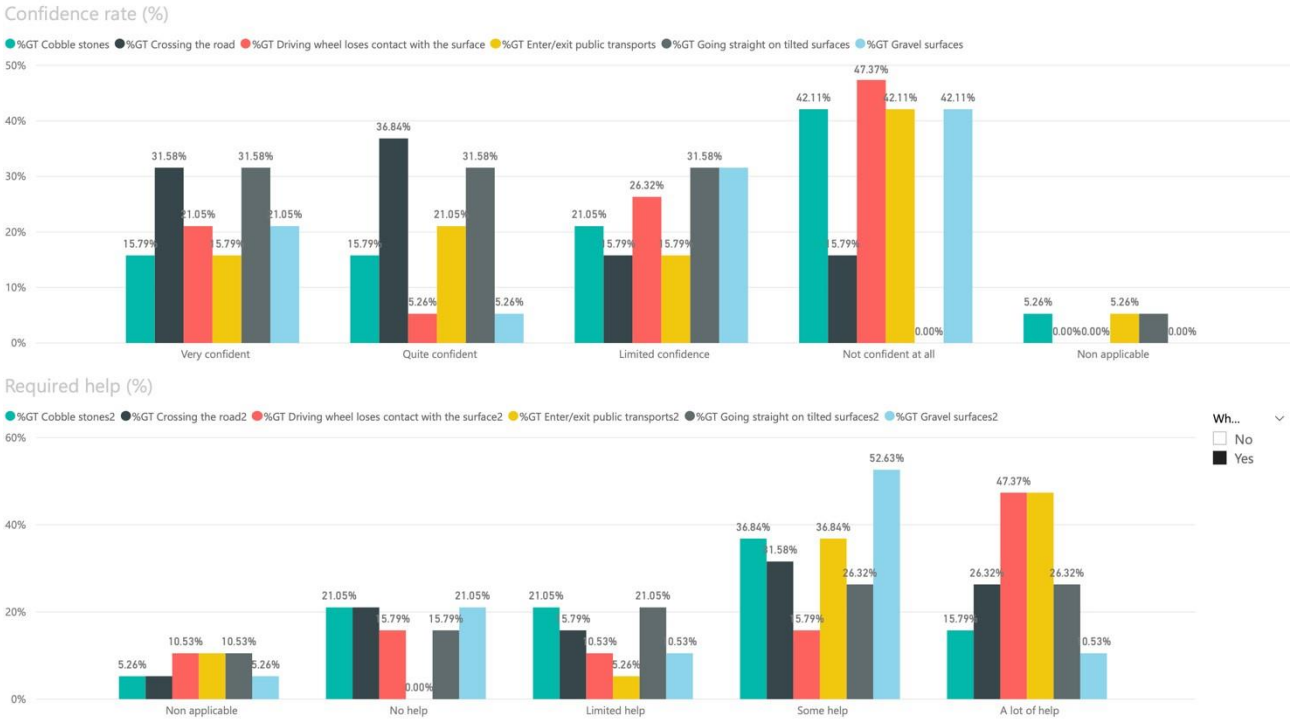


Figure 9: Confidence rate versus required help, answers by wheelchair users, N=19 (%)

4.2.2 The driving assistance system

After drawing attention to the different places where wheelchair users felt confident or not and where they required help or not, this survey showed that 65% of the total respondents think that the driving assistance system might help a lot to give users more confidence and feel more safely while driving. Among the 72 answers, 63% of the wheelchair users think it might help a lot and 26% think it might help a bit. The main benefits that would bring this new system is a higher autonomy (67%), users would feel safer (82%) and more confident to go outside as well (78%). Additionally, if the new system is partially based on smart technologies, the respondents would prefer to use their smartphone coupled with the PWC at 67%. It is the case, especially for the younger generation. From 18 to 49 years old, 77% of the wheelchair users (13 persons) prefer to use their smartphone. On the contrary, 67% of the wheelchair users (6 persons) aged between 60 and 69 favour a dedicated smart device installed on the armrest.

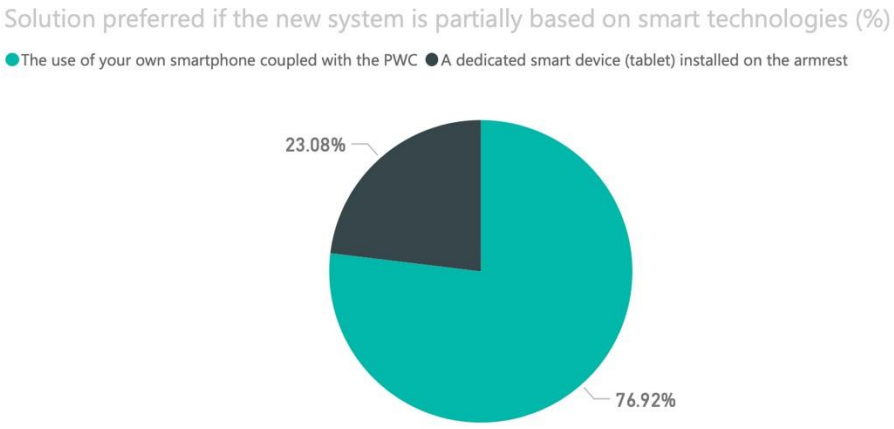


Figure 10: Solution preferred by wheelchair users ageing from 18 to 49, N=13 (%)

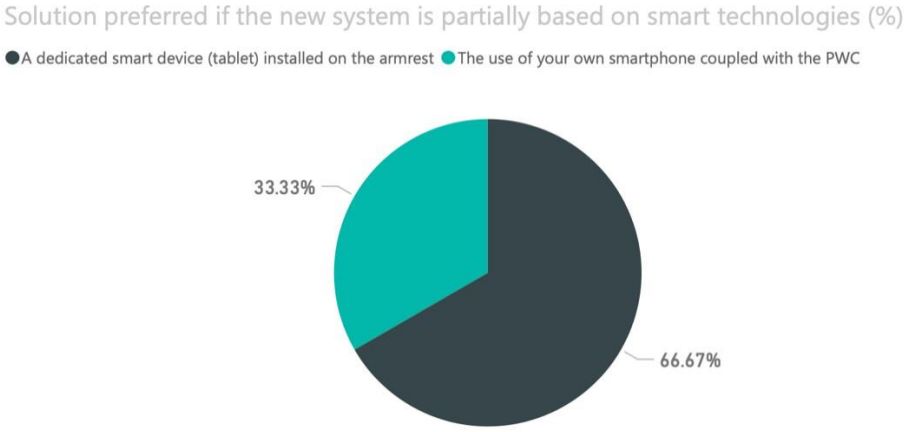


Figure11: Solution preferred by wheelchair users ageing from 60 to 69, N=6 (%)

4.3 Willingness to pay for EDUCAT's assistive technologies

When focusing on the respondents that think the new system might help wheelchair users (65 out of 72 persons), the analysis of the willingness to pay demonstrates that 34% would buy the new system, 31% would rent it with a buy option and 20% would rent it as service. On top of that, 35% of them would buy the product for less than 500€, 25% for a price that is between 500€ and 800€. If the rent option is preferred, 28% would rent it for 15€ to 20€ and the same amount of people for less than 15€. Nonetheless, whether people want to buy or rent the product, 23% of the respondents don't want to pay for the system (Figure 12).

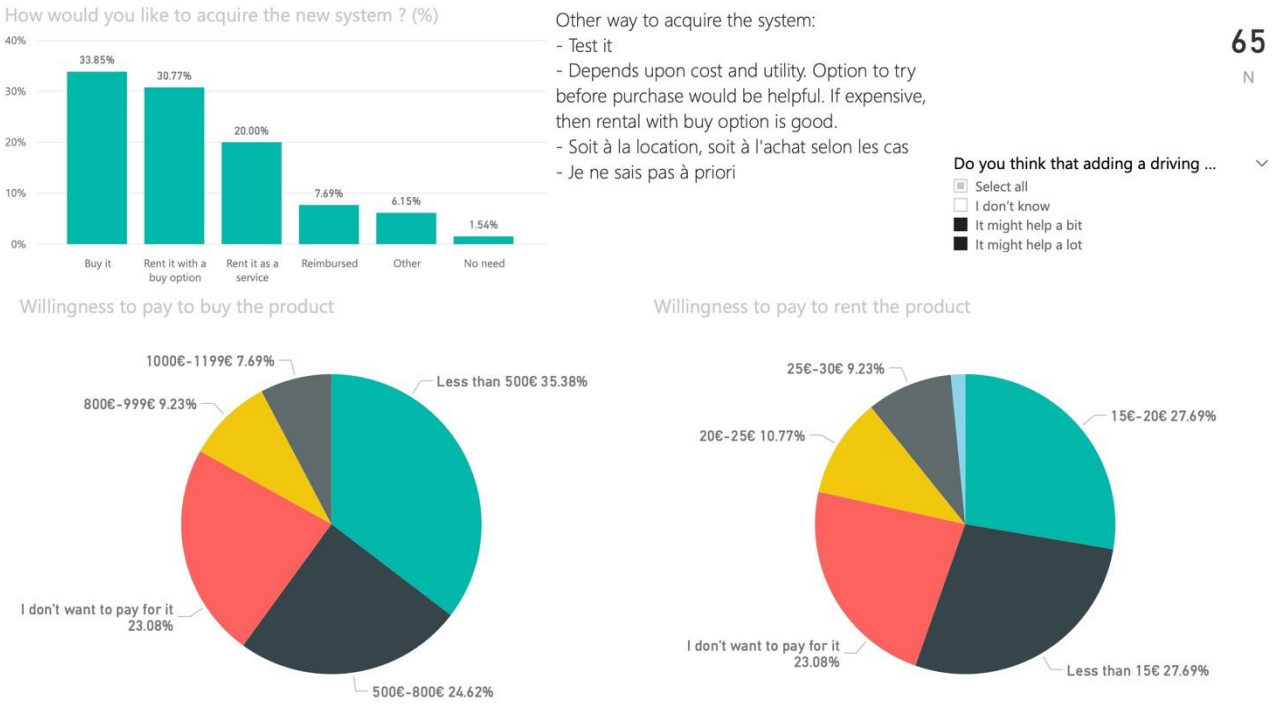


Figure 12: Overall willingness to pay for people thinking the new system might help, N=65

Furthermore, some differences exist between Belgium, France and the United Kingdom.

In Belgium, 69% of the respondents would rent the new system for 15€ to 20€ (38%), or a price lower than 15€ (31%), or 25€ to 30€ (19%). Buying the product is the least favourite option, 25% of the respondents chose this option. 38% would pay less than 500€, 31% would buy it for a price between 500€ and 800€, and 19% would pay between 800€ and 999€ (Figure).

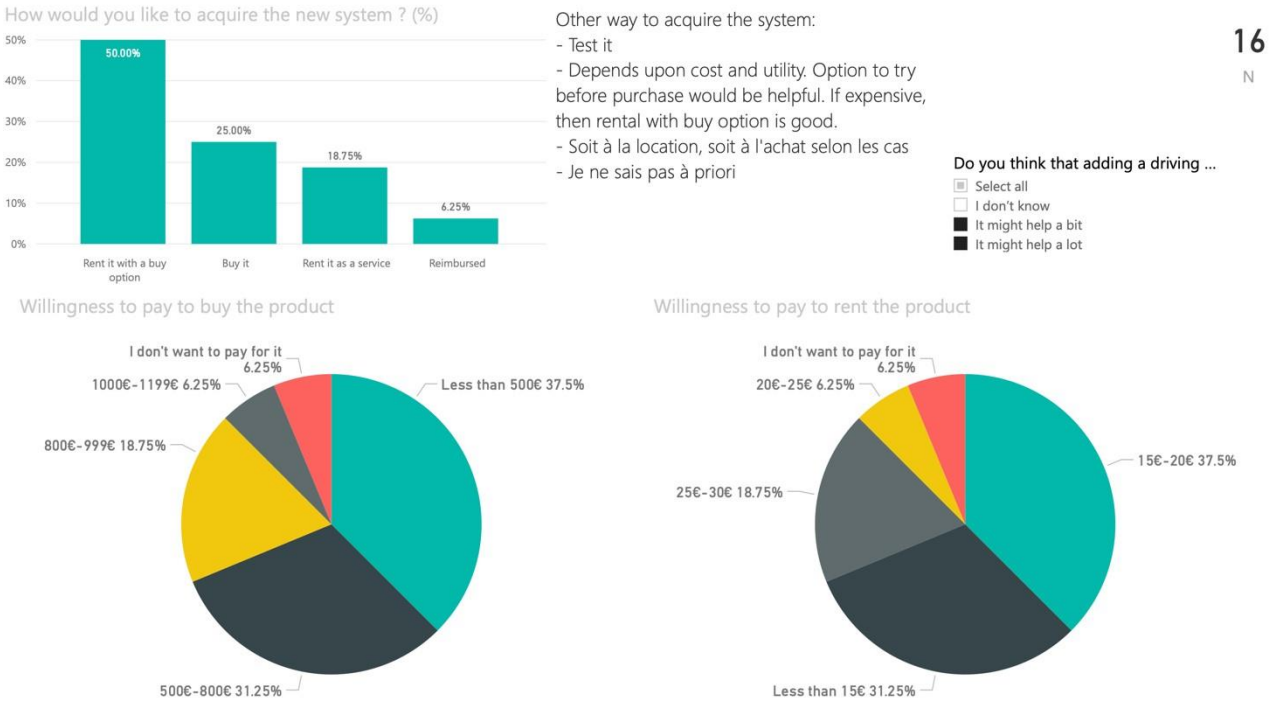


Figure13: Overall willingness to pay in Belgium, N=16

In France, 40% would buy the new system for less than 500€ (40%) or for a price between 500€ and 800€ (20%). Renting the new device is the second preferred option (20% if it is done with a buy option and 17% if it is a service) for less than 15€ (33%) or for a price ranging between 15€ and 20€ (27%). Nonetheless, 33% of the respondents don't want to buy it at all (Figure 14).

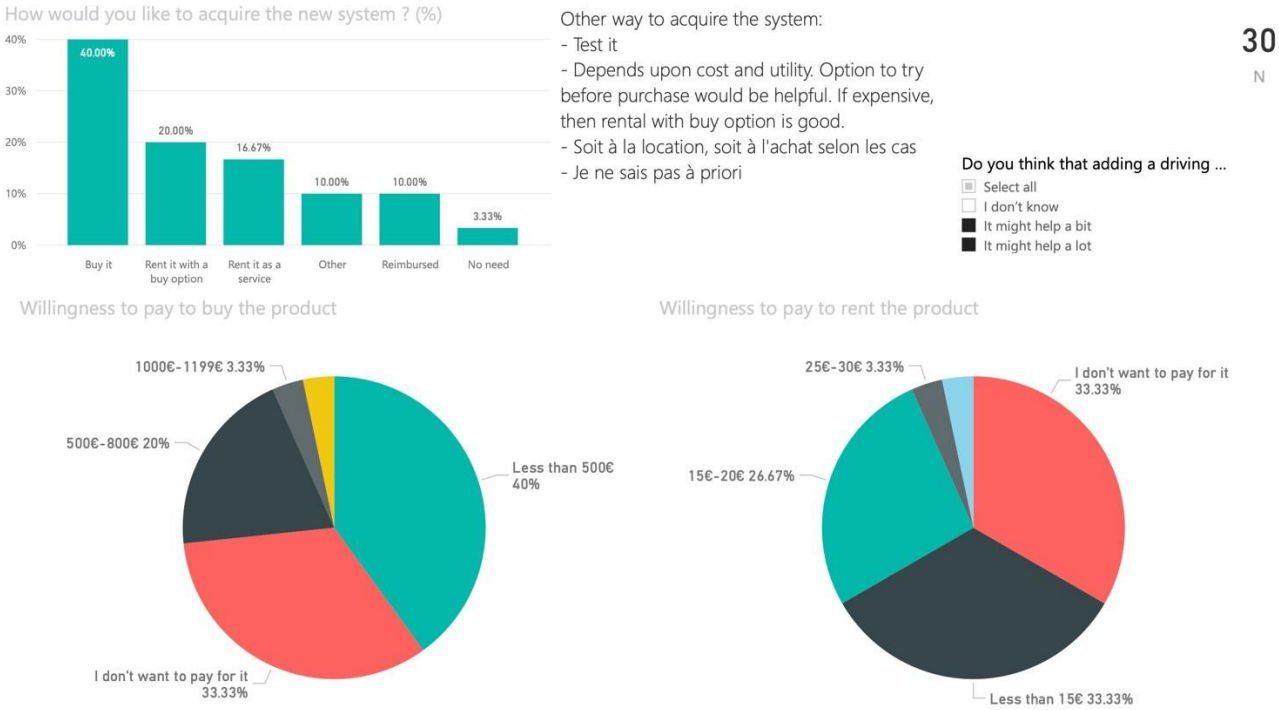


Figure 14: Overall willingness to pay in France, N=30

In the United Kingdom, 59% of the respondents would rent the new system for a price between 20€ and 25€ (29%) or for 15€ to 20€ (24%), or between 25€ and 30€ (12%). Buying the product is the least favourite option, 29% of the respondents chose this option. 24% would buy it for a price between 500€ and 800€, 24% would pay less than 500€, 18% would pay between 1,000€ and 1,199€, and 12% would pay between 800€ and 999€. Nonetheless, 24% of the respondents do not want to buy it at all (Figure 5).

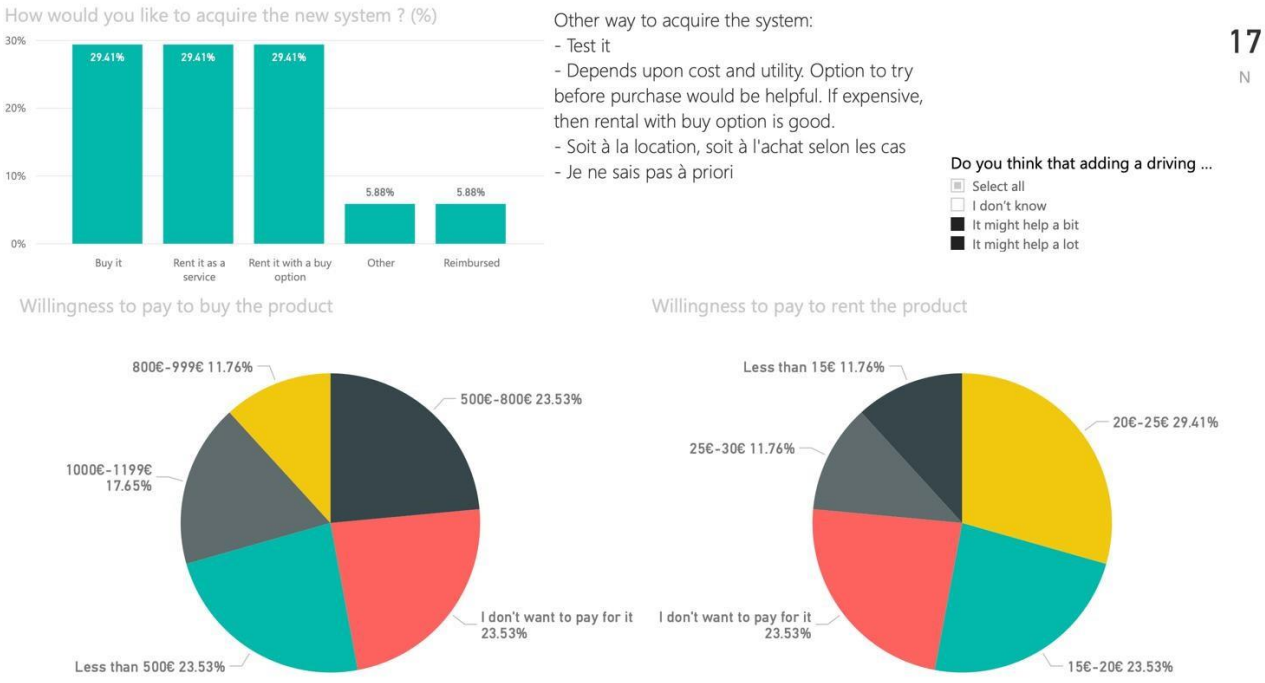


Figure 15: Overall willingness to pay in the United Kingdom, N=17

4.4 Market potential for EDUCAT's assistive technologies

4.4.1 Different ways to access the markets

The system can help wheelchair users to avoid obstacles that could not be avoided or seen. Therefore, it might help them in environments where they feel less or not confident at all, such as public transports, when encountering challenging environments with gravel surfaces or cobblestones. It can help users to drive safely and more confidently which can increase their autonomy.

When looking at the preferred option to acquire the new system, the buying option is favoured in France according to 40% of the respondents coming from France, whereas in Belgium it is 25%. On the contrary, Belgian respondents prefer a renting option according to 50% of them if a buy option is attached to it and 19% if it is a service. In France, those numbers are much lower, 20% of people would rent it with a buy option and 17% as a service (Table 111).

Table 11: Acquisition options per country (%)

Option	Belgium (N=16)	France (N=30)	United Kingdom (N=17)
Buy it	25.00%	40.00%	29.41%
Rent it with a buy option	50.00%	20.00%	29.41%
Rent it as a service	18.75%	16.67%	29.41%
Reimbursed	6.25%	10.00%	5.88%

4.4.2 Willingness to buy the new system

The survey distinguished four different price level between 250€ and 1,199€, according to which the market potential is dependant (Table 12). The latter corresponds to the minimum and the maximum number of potential buyers in each country after studying the market in Belgium and in France. The market potential of the United Kingdom is not included in this study. In Belgium, the number of wheelchair users is estimated between 24,416 and 50,908. In France, it is estimated at 140,000.

After studying the willingness to buy the new system, the market potential for each price level was calculated. If the price is between 500€ and 800€, 60% of the respondents would be willing to pay this price. The resulting market potential would be equal to 2,563,680€ or 5,345,340€ when considering that the number of buyers is 24,416 or 50,908 respectively (Table 13 and Table 14). Whereas in France, 40% of the respondents would be willing to pay the same price, resulting in a market potential equal to 15,672,160€.

Table 12: Willingness to buy the product in each country (%)

WTP to buy	Belgium (N=16)	France (N=30)	United Kingdom (N=17)
Less than 500€	40.00%	60.00%	30.77%
500€-800€	33.33%	30.00%	30.77%
800€-999€	20.00%	4.99%	15.38%
1000€-1199€	6.67%	4.99%	23.08%
I don’t want to pay for it	6.25%	33.33%	23.53%

Table 13: Market potential of minimum buyers in each country (€)

Market potential of minimum buyers	Belgium (N=16) Number of minimum buyers = 24416	France (N=30)
250 €	1'526'000.00 €	13'997'200.00 €
700 €	2'563'680.00 €	15'672'160.00 €
900 €	1'465'143.12 €	5'029'920.00 €
1 100 €	447'850.48 €	3'073'840.00 €

Table 14: Market potential of maximum buyers in each country (€)

Market potential of maximum buyers	Belgium (N=16) Number of maximum buyers = 50908	France (N=30)
250 €	3'181'750.00 €	13'997'200.00 €
700 €	5'345'340.00 €	15'672'160.00 €
900 €	3'054'861.81 €	5'029'920.00 €
1 100 €	933'779.99 €	3'073'840.00 €

4.4.3 Willingness to rent the new system

Concerning the willingness to rent the new system, five price level were defined from 12.5€ to 35€ (Table).

The market potential for each price level was calculated. If the price is between 15€ and 20€, 67% of the respondents would be willing to pay this price. The resulting market potential would be equal to 195,846.46€ or 408,345€ when considering that the number of buyers is 24,416 or 50,908, respectively (Table 16 and Table). When looking at the market potential in France, the same price range as Belgium would give the best results, which means for a price between 15€ and 20€, the market potential would be equal to 449,117.66€.

Table15: Willingness to rent the product in each country (%)

WTP to rent	Belgium (N=16)	France (N=30)	United Kingdom (N=17)
Less than 15€	33.33%	50.00%	15.38%
15€-20€	40.00%	40.01%	30.77%
20€-25€	6.67%	0.00%	38.46%
25€-30€	20.00%	4.99%	15.38%
More than 30€	0.00%	4.99%	0.00%
I don’t want to pay for it	6.25%	33.33%	23.53%

Table 16: Market potential of minimum renters in each country (€)

Market potential of minimum renters	Belgium (N=16) Number of minimum renters = 24,416	France (N=30)
7,5 €	125'895.00 €	384'996.50 €
17,5 €	195'846.46 €	449'117.66 €
22,5 €	100'728.59 €	115'279.48 €
27,5 €	92'323.00 €	140'897.14 €
32,5 €	0.00 €	83'257.40 €

Table17: Market potential of maximum renters in each country (€)

Market potential of maximum renters	Belgium (N=16) Number of maximum renters = 50,908	France (N=30)
7,5 €	262'494.38 €	384'996.50 €
17,5 €	408'345.00 €	449'117.66 €
22,5 €	210'021.75 €	115'279.48 €
27,5 €	192'495.88 €	140'897.14 €
32,5 €	0.00 €	83'257.40 €

It is necessary to interpret those results with cautious as the sample is small, especially when focusing on wheelchair users. They were only 19 persons that answered the survey.

Depending on the country, price and acquisition options differ from one country to another. This could be mainly driven by differences in the healthcare system which impact the end consumer's choice.

4.4.4EDUCAT Market Estimates for OAS and AAMS

Because of the covid-19 crisis we won't be abble to realize testing with PW users, we propose in this paragraph an cost saving estimation based on littérature review and own experience induced by AAM and OAS.

It is mainly admitted that main criteria to be considered when choosing a wheelchair are:

✓ The pathology of the patient and its evolution

✓ The morphology of the patient (weight, height, ...), the patient's environment

✓ Activities of daily life (professional and leisure)

In other terms , considering ederly people we can suppose that pathology, and morphology won't evoluate. in time. The main actions should be focused on the capacity of the wheelchair to be the most adapted to the environment perception, wheelchair control and activities of day life.

In 2010, Edward and all wrote in [1] that power-mobility devices have many benefits for users, but can also have negative outcomes, like abandon of the device due to discomfort or lack of training, accidents resulting in injuries,.A study found that 21 % of users of PWC had an accident within a year of receiveing their device. Training coupled with active follow-up also induces reduce accidents and improve fitting of the device as provide.

In 2015 Renzo and al.[2] wrote that in relation to the economic impact, the provision of a powered wheelchair generated remarkable savings in social costs for most of the users, on average about 38.000 Euros per person on a projected 5-years span. The results indicated positive outcomes, especially in relation to user satisfaction and psychosocial impact, this is conformed in [3] authors wrote an overall positive psychosocial impact of the PW in all three PIADS areas (competence, adaptability and self-esteem) and in the PIADS total score, regardless age, with a potential increase in the QoL. The best participation profiles were noted among the most satisfied users.

A number of barriers were identified in various settings that sometimes restrict user mobility, and suggest corrective actions such as system of collision avoidances, help to navigator with helpful display. In[4], the mean societal savings based on calculated costs for assistance (assistance for outdorr mobility…) is estimated to €6227 per person per year. Conclusions: PWC seems to improve occupational performance, social participation and life satisfaction for users. Moreover, these improvements seem to have an economic advantage for both users and society.

Considering these different studies and the Educat's market study[5], we can assume that the potential of using OAS&AMMS (system of collisions avoidance; a tablet display of surrounding environment, a rear camera, facilitate navigation, and a patient centered data analysis) will decrease the negatives outcomes pointing out by Edward&al by decreasing accident, abandon and improving training thus favorising the PWD's adoption by users and physiotherapists.

In this basis; if we assume that OAS will reduced by 20% the cost assistance . of an increase of smart PWD's users of 60% based to the growing estimation of the market, it is realistic to say that the EDUCAT project impact on effective cost will be positive for both users and society. Moreover, if the OAS and AAMS enable those who would not otherwise meet the prescription criteria to have a PWC ; and enable a user to continue to use their PWC as their disability develops; then the savings are estimated as approximately €7000/year. Even if the decrease of assistance would be just one hour/week (1924€/year), the use of smart PWC should be profitable for the society as demosntrate below :

- France, with 150000 renews chair by year(PP20), and if we assume that 10% were PWC(PP16), and that 80%(PP24) of them are equiped with our system we can estimate : 150000*0.1*0.8*1924=24531000€ of cost saving for France per year!!!
- Belgium 2928 renewed chairsby year (PP11), and that 80 of them are equiped with our system we can estimate : 2928*0.8*1924=4506777€ of cost saving for Belgium a year!!!
- TOTAL : 29037777€ of cost saving per year

[1]..' A survey of adult power wheelchair and scooter users [Kara Edwards &Annie MccluskeyPages 411-419 | Accepted 01 Mar 2010, Published online: 08 May 2010].

[2] An observational study of powered wheelchair provision in Italy Claudia Salatino , Renzo Andrich , R M Converti , M Saruggia

[3] Powered wheelchairs and scooters for outdoor mobility: a pilot study on costs and benefits Kersti Samuelsson &Ewa Wressle

[4] Psychosocial Impact of Powered Wheelchair, Users' Satisfaction and Their Relation to Social Participation Inês Domingues , João Pinheiro João Silveira , Patrícia Francisco Jeffrey Jutai andAnabela Correia Martins

[5] : Marketoverview (EDUCAT)

5. Annexe 1: Survey

Market Potential Survey (Copy)

In this questionnaire, we are going to evaluate the market potential of the driving assistance technologies for wheelchairs (manual or electric).
We are a team of researchers, clinical scientists, engineers and healthcare professionals from UK, France and Belgium working for the European project EDUCAT www.educat2seas.eu.

The purpose of the survey is to provide an answer to the following questions:
- What are the needs of wheelchair users & their carers?
- What benefits have the new technologies for them in their daily life?
- What is the willingness to pay for the new technologies as an option to your wheelchair?

The report with the results of this survey will be available in June 2020 on our website.
If you have any questions or additional requests you can contact us by e-mail educat.interreg@gmail.com

Required

General Information

1. To which category do you belong?

   Select your answer

2. Do you use a wheelchair?

   ◯ Yes

   ◯ No

3. Which kind of wheelchair do you use?

Select your answer

4. Did you participate in the choice of the wheelchair?

- ◯ No, I wasn't involved
- ◯ I gave some advice
- ◯ I suggested a list of the most appropriate options
- ◯ I chose it
- ◯ Other

5. Do you sometimes need assistance to operate your wheelchair?

- ◯ Yes
- ◯ No

6. In which situation do you need help?

- ☐ When tired
- ☐ Feeling unwell
- ☐ Challenging environments
- ☐ Other

7. How many powered functions do you have in your wheelchair?

	0	1	2	3	4	5	More than 5
Powered Functions	◯	◯	◯	◯	◯	◯	◯

8. How do you control your wheelchair?

- ◯ Standard joystick
- ◯ Specialised joystick
- ◯ Chin joystick
- ◯ Switches (head, hand, foot, other)
- ◯ Sip and puff
- ◯ Other

9. Which range of disabilities do you have?

- ☐ Mobility and Physical Impairments
- ☐ Spinal Cord Disability
- ☐ Head Injuries (TBI) - Brain Disability
- ☐ Hearing Disability
- ☐ Cognitive or Learning Disabilities
- ☐ Psychological Disorders
- ☐ Other

10. How confident do you feel when driving the wheelchair in the following environments?

	Not confident at all	Limited confidence	Quite confident	Very confident	Non applicable
Kitchen	◯	◯	◯	◯	◯
Bedroom	◯	◯	◯	◯	◯
Living room	◯	◯	◯	◯	◯
Bathroom	◯	◯	◯	◯	◯

	Not confident at all	Limited confidence	Quite confident	Very confident	Non applicable
Garden	○	○	○	○	○
Elevator	○	○	○	○	○
At work	○	○	○	○	○
At school	○	○	○	○	○
In a hospital	○	○	○	○	○
In a shopping center	○	○	○	○	○
In a restaurant	○	○	○	○	○
In public transportation	○	○	○	○	○
In a park	○	○	○	○	○
In the fields	○	○	○	○	○
Leisure/Sports	○	○	○	○	○
In the street	○	○	○	○	○
In traffic	○	○	○	○	○

11. How confident do you feel when driving the wheelchair in the following situations?

	Not confident at all	Limited confidence	Quite confident	Very confident	Non applicable
On the carpet	○	○	○	○	○
In a crowd	○	○	○	○	○
Crossing the road	○	○	○	○	○
Enter/exit public transports	○	○	○	○	○
Going straight on tilted surfaces	○	○	○	○	○

	Not confident at all	Limited confidence	Quite confident	Very confident	Non applicable
Driving wheel loses contact with the surface	○	○	○	○	○
Steep hills and slopes	○	○	○	○	○
Paved surfaces	○	○	○	○	○
Gravel surfaces	○	○	○	○	○
Cobble stones	○	○	○	○	○
Pot holes in the pavement	○	○	○	○	○
Kerbs	○	○	○	○	○

12. To what degree do you think this technology might help the user in the following environment circumstances?

	No help	Limited help	Some help	A lot of help	Non applicable
Kitchen	○	○	○	○	○
Bedroom	○	○	○	○	○
Living room	○	○	○	○	○
Bathroom	○	○	○	○	○
Garden	○	○	○	○	○
Elevator	○	○	○	○	○
At work	○	○	○	○	○
At school	○	○	○	○	○
In a hospital	○	○	○	○	○
In a shopping center	○	○	○	○	○
In a restaurant	○	○	○	○	○
In public transportation	○	○	○	○	○

	No help	Limited help	Some help	A lot of help	Non applicable
In a park	○	○	○	○	○
In the fields	○	○	○	○	○
Leisure/Sports	○	○	○	○	○
In the street	○	○	○	○	○
In traffic	○	○	○	○	○

13. To what degree do you think this technology might help the user in the following situations?

	No help	Limited help	Some help	A lot of help	Non applicable
On the carpet	○	○	○	○	○
In a crowd	○	○	○	○	○
Crossing the road	○	○	○	○	○
Enter/exit public transports	○	○	○	○	○
Going straight on tilted surfaces	○	○	○	○	○
Driving wheel loses contact with the surface	○	○	○	○	○
Steep hills and slopes	○	○	○	○	○
Paved surfaces	○	○	○	○	○
Gravel surfaces	○	○	○	○	○
Cobble stones	○	○	○	○	○
Pot holes in the pavement	○	○	○	○	○
Kerbs	○	○	○	○	○

14. Assuming this new system is partially based on smart technologies. What kind of solution would you prefer?

- ◯ The use of your own smartphone coupled with the PWC
- ◯ A dedicated smart device (tablet) installed on the armrest

15. If a smart device is coupled with your wheelchair, which features are important for you?

- ☐ To have a large screen
- ☐ To charge the device via the wheelchair
- ☐ To interact with your wheelchair using the screen touch (lights, battery state, etc.)
- ☐ Other

16. What do you think that this technology might bring you or the wheelchair users?

- ☐ Higher autonomy
- ☐ Improvement of the social life
- ☐ Feel more confident to go outside
- ☐ Higher self-confidence
- ☐ Improvement of the wheelchair's control
- ☐ Feel safer
- ☐ Feel more free
- ☐ Reduction of the damages in the house
- ☐ Other

17. Do you think that adding a driving assistance system to the powered wheelchair might help users to drive more safely and confidently?

- ◯ Not at all
- ◯ It might help a bit
- ◯ It might help a lot
- ◯ I don't know

18. If the driving assistance is on the market, how would you like to acquire it?

- ◯ Buy it
- ◯ Rent it as a service
- ◯ Rent it with a buy option
- ◯ Other

19. If the driving assistance option is on the market, how much will you be willing to pay to buy it?

- ◯ Less than 500€
- ◯ 500€-800€
- ◯ 800€-999€
- ◯ 1000€-1199€
- ◯ 1200€-1500€
- ◯ More than 1500€
- ◯ I don't want to pay for it

20. If the driving assistance option is on the market, how much will you be willing to pay by month to rent it?

- ◯ Less than 15€
- ◯ 15€-20€
- ◯ 20€-25€

- ◯ 25€-30€
- ◯ More than 30€
- ◯ I don't want to pay for it

21. If you have to choose between several technologies that might improve your experience as wheelchair user, which ones you would like the most?

You can chose only 3 of them and order them by preference (1 – the most important, 3- the less important)

	Driving assistance system	Autonomous parking system	Rear camera	Fast charger	Lithium batteries	Display with a better visibility
Preference 1	◯	◯	◯	◯	◯	◯
Preference 2	◯	◯	◯	◯	◯	◯
Preference 3	◯	◯	◯	◯	◯	◯

22. Do you have any suggestions how driving assistance technologies might help carers and users to drive a PWC more confidently and safely?

Enter your answer

23. How old are you?

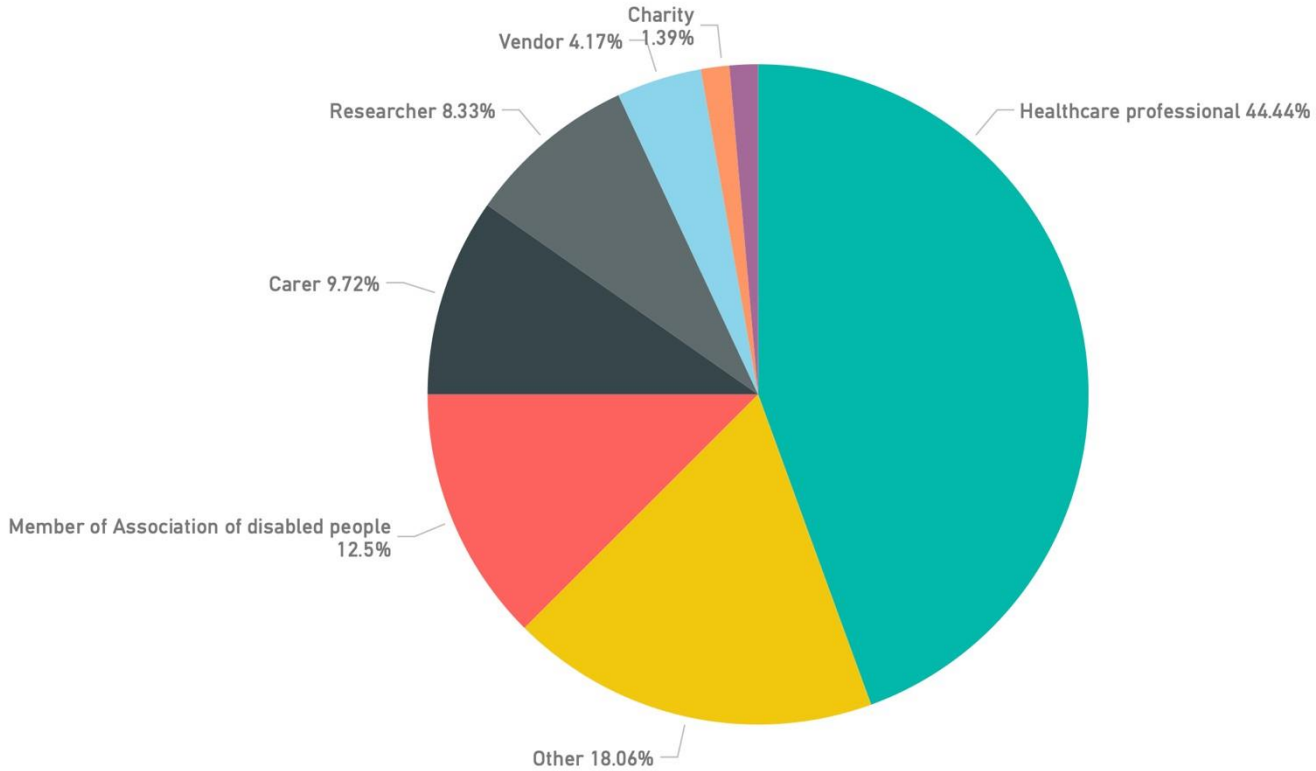
Select your answer

24. In which country do you live?

Select your answer

6. Annexe 2: Survey results

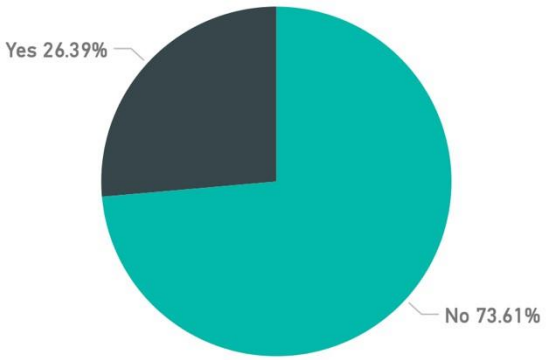
Respondant category (%)



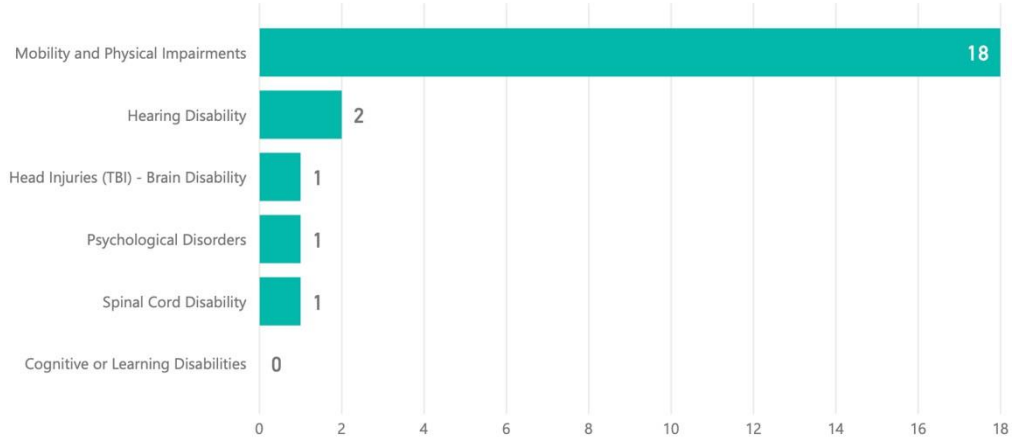
Other category :
- Enseignante mission accueil handicap
- Personne se déplaçant en fauteuil électrique
- PhD Student in occupational therapy
- Caring towards disability
-Designer d'innovation
- Utilisateur
- Retraité
- Wheelchair user
- Werkgeversorganisatie
- Disabled
- Wheelchair user

72
N

Proportion of wheelchair users (%)

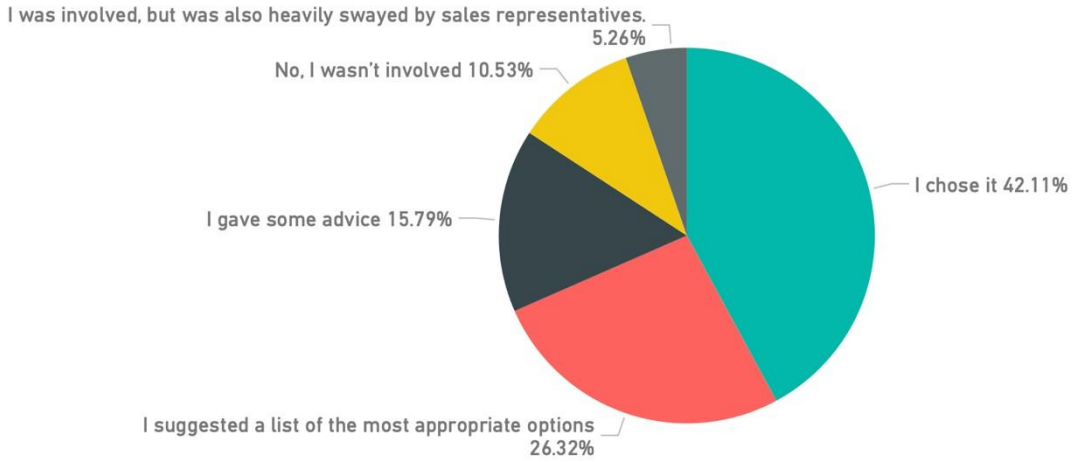


Range of disabilities (abs)



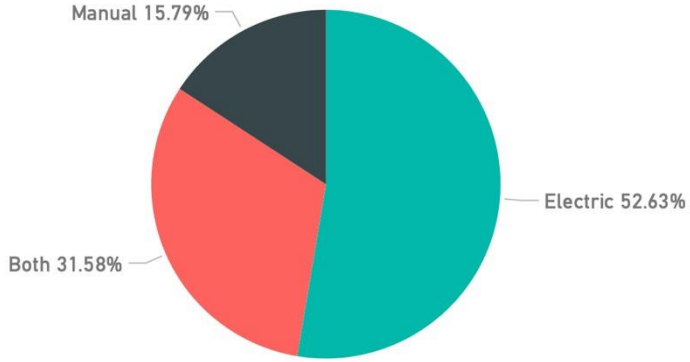
Other disability:
- Bad sight

Participation in the choice of the wheelchair (%)

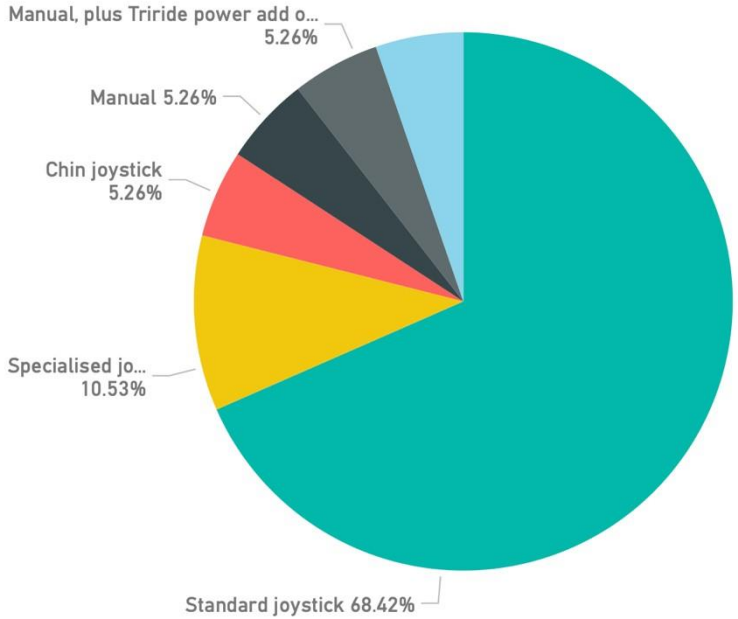


72
N

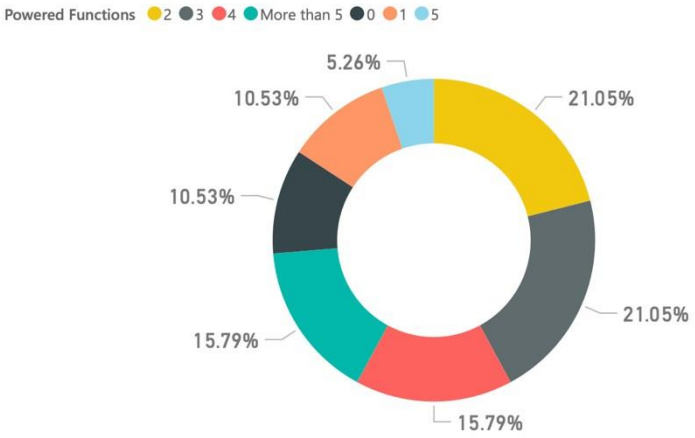
Type of wheelchair (%)



Wheelchair control (%)



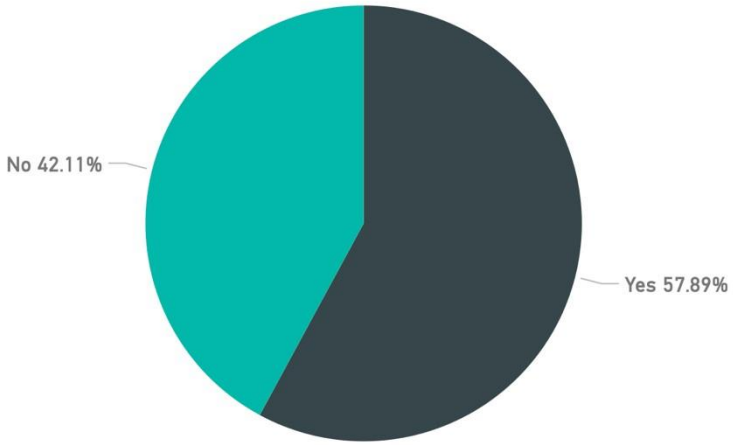
Range of powered functions (%)



72

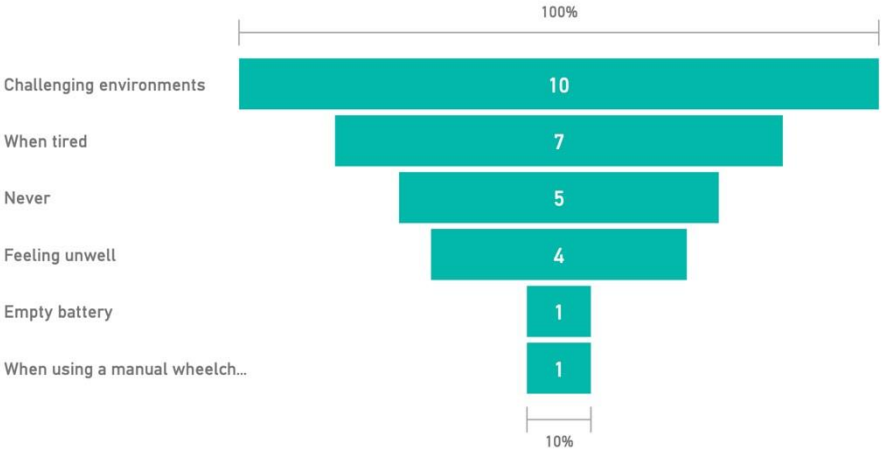
N

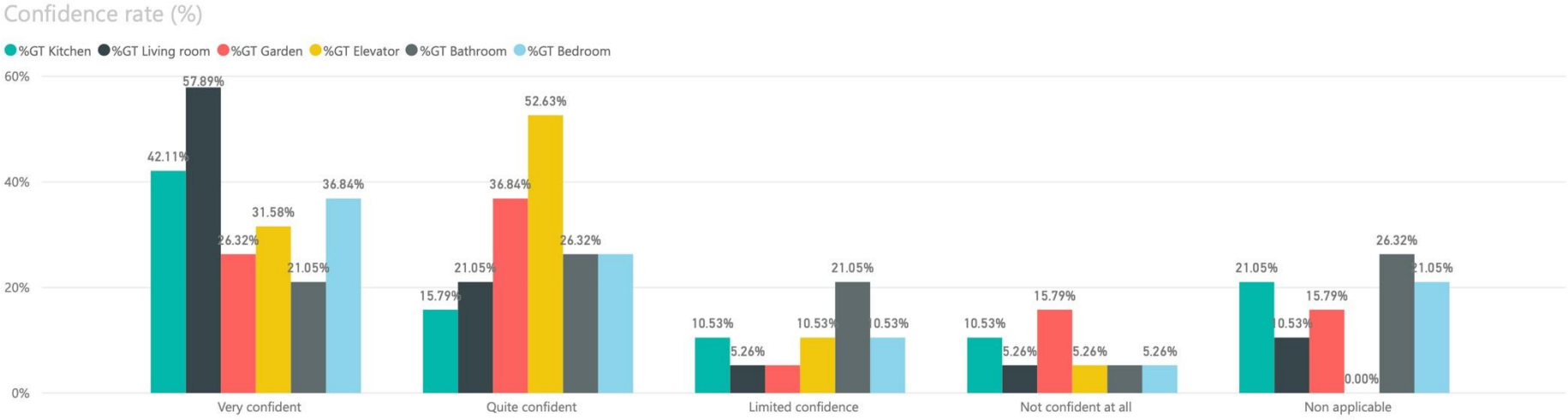
Assistance needed to operate their wheelchair (%)

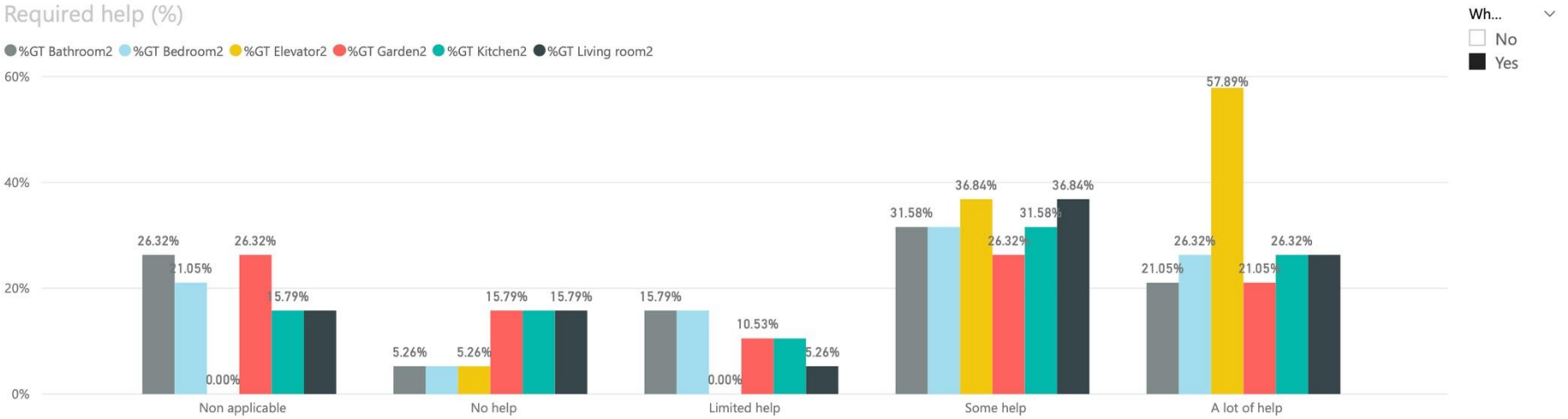


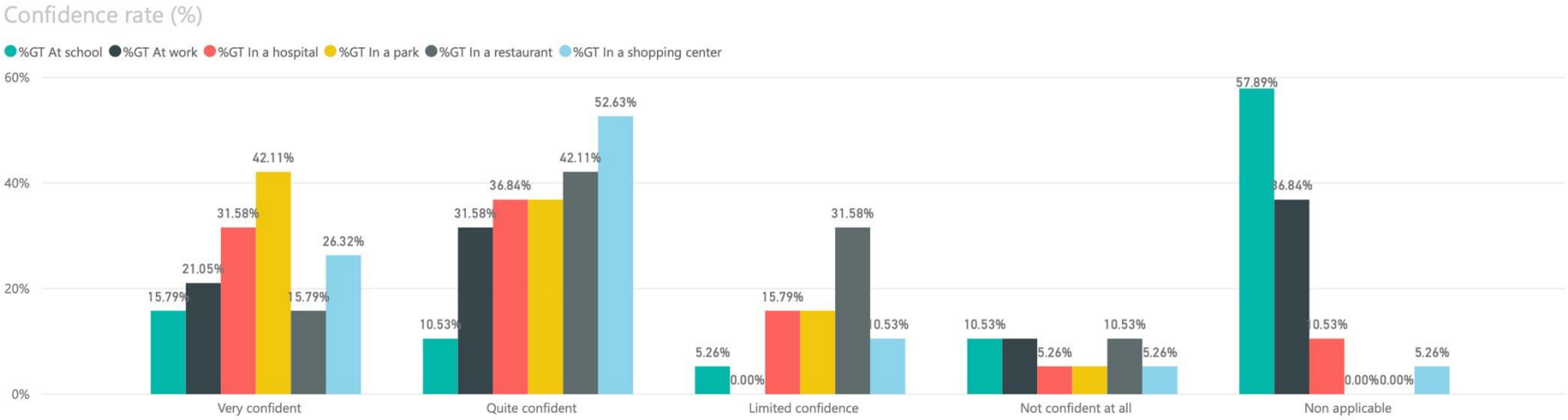
72
N

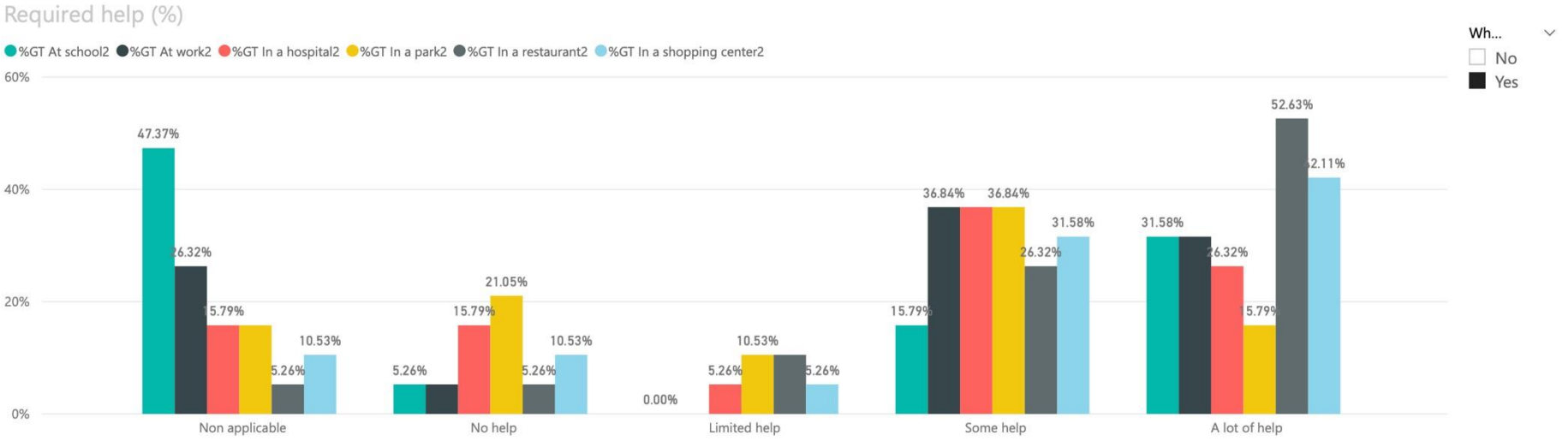
Situation requiring help (abs)

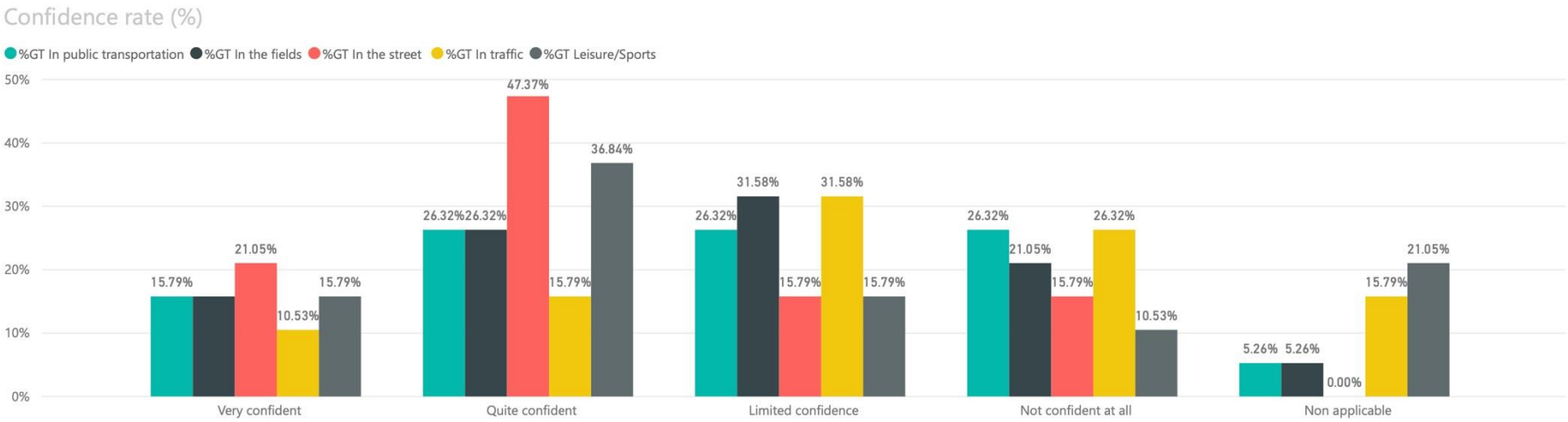


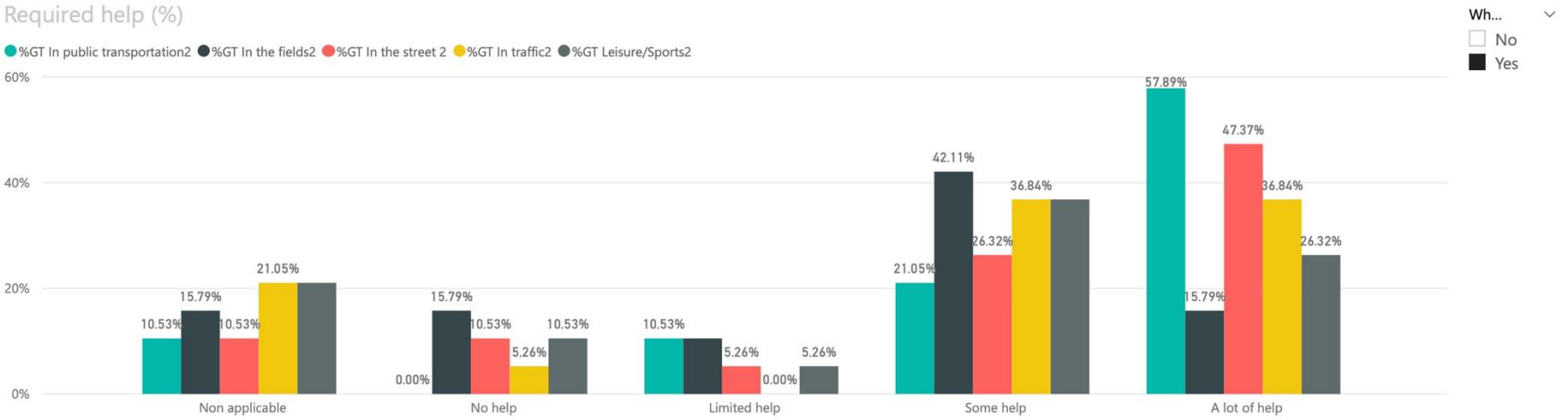

Confidence rate (%)
%GT Kitchen
%GT Living room
%GT Garden
%GT Elevator
%GT Bathroom
%GT Bedroom
60%
40%
20%
0%
42.11%
57.89%
26.32%
31.58%
21.05%
36.84%
15.79%
21.05%
36.84%
52.63%
26.32%
10.53%
5.26%
10.53%
21.05%
10.53%
10.53%
5.26%
15.79%
5.26%
5.26%
21.05%
10.53%
15.79%
0.00%
26.32%
21.05%
Very confident
Quite confident
Limited confidence
Not confident at all
Non applicable

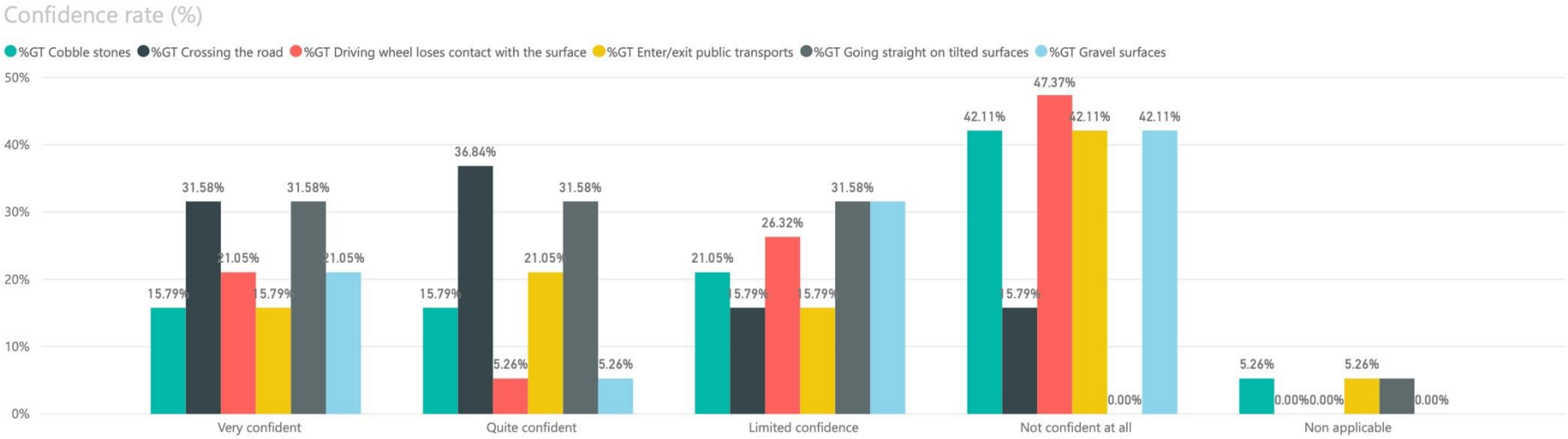

Required help (%)
%GT Bathroom2
%GT Bedroom2
%GT Elevator2
%GT Garden2
%GT Kitchen2
%GT Living room2
Wh...
No
Yes
60%
40%
20%
0%
26.32%
21.05%
0.00%
26.32%
15.79%
5.26%
5.26%
15.79%
15.79%
15.79%
0.00%
10.53%
5.26%
31.58%
31.58%
36.84%
26.32%
31.58%
36.84%
21.05%
26.32%
57.89%
21.05%
26.32%
Non applicable
No help
Limited help
Some help
A lot of help

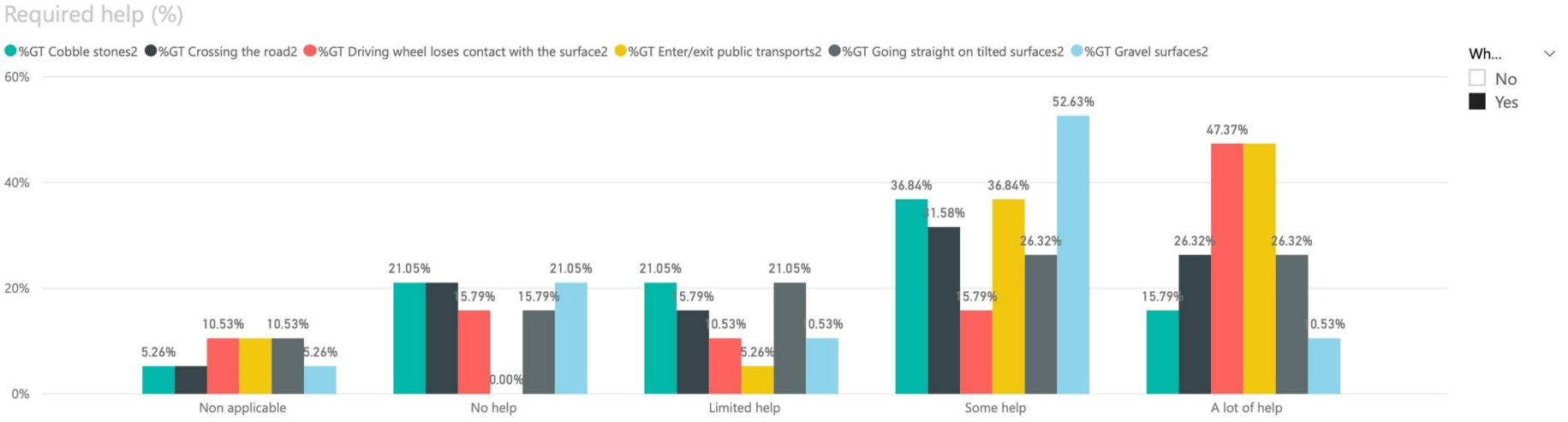

Confidence rate (%)
%GT At school
%GT At work
%GT In a hospital
%GT In a park
%GT In a restaurant
%GT In a shopping center
60%
40%
20%
0%
15.79%
21.05%
31.58%
42.11%
15.79%
26.32%
10.53%
31.58%
36.84%
42.11%
52.63%
5.26%
0.00%
15.79%
31.58%
10.53%
10.53%
5.26%
10.53%
5.26%
57.89%
36.84%
10.53%
0.00%
0.00%
5.26%
Very confident
Quite confident
Limited confidence
Not confident at all
Non applicable

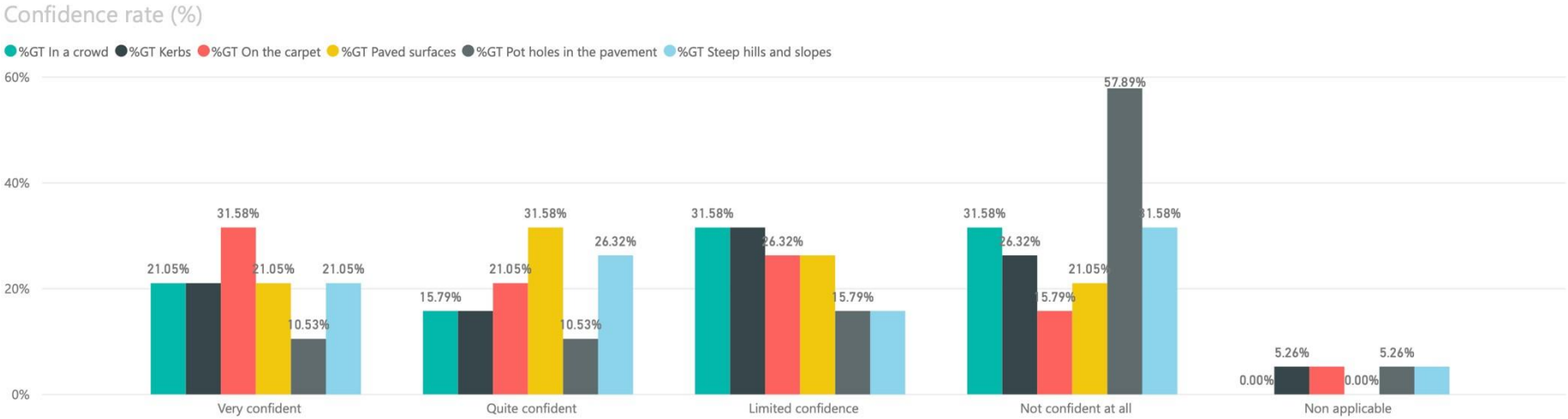

Required help (%)
%GT At school2
%GT At work2
%GT In a hospital2
%GT In a park2
%GT In a restaurant2
%GT In a shopping center2
Wh...
No
Yes
60%
40%
20%
0%
47.37%
26.32%
15.79%
5.26%
10.53%
5.26%
15.79%
21.05%
5.26%
10.53%
0.00%
5.26%
10.53%
5.26%
15.79%
36.84%
36.84%
26.32%
31.58%
31.58%
26.32%
15.79%
52.63%
42.11%
Non applicable
No help
Limited help
Some help
A lot of help

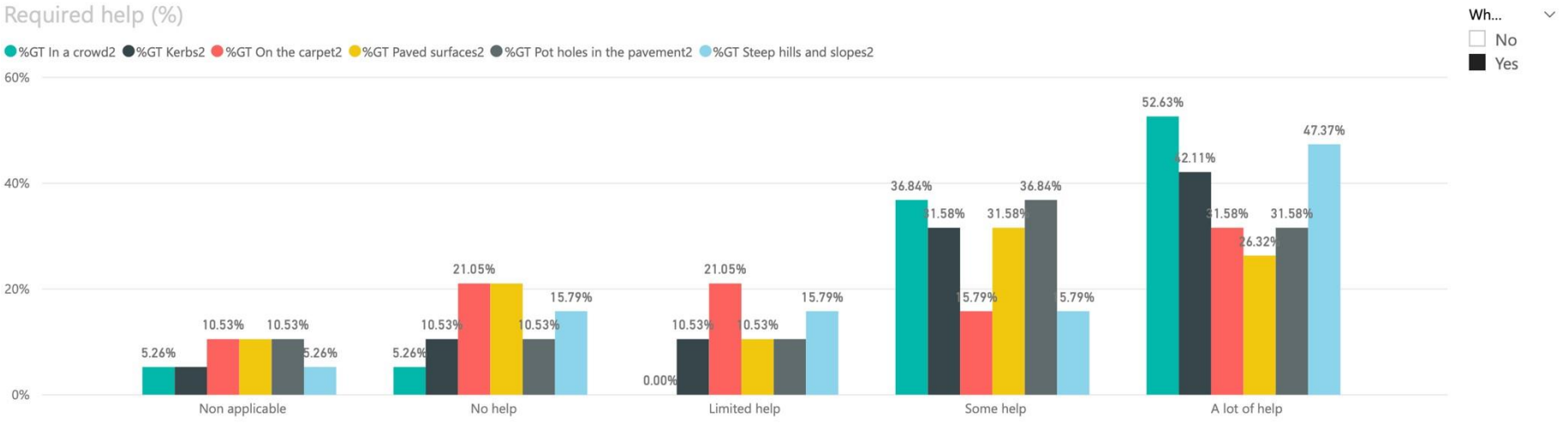

Confidence rate (%)
%GT In public transportation
%GT In the fields
%GT In the street
%GT In traffic
%GT Leisure/Sports
50%
40%
30%
20%
10%
0%
15.79%
15.79%
21.05%
10.53%
15.79%
26.32%
26.32%
47.37%
15.79%
36.84%
26.32%
31.58%
15.79%
31.58%
15.79%
26.32%
21.05%
15.79%
26.32%
10.53%
5.26%
5.26%
0.00%
15.79%
21.05%
Very confident
Quite confident
Limited confidence
Not confident at all
Non applicable


Required help (%)
%GT In public transportation2
%GT In the fields2
%GT In the street 2
%GT In traffic2
%GT Leisure/Sports2
Wh...
No
Yes
60%
40%
20%
0%
10.53%
15.79%
10.53%
21.05%
21.05%
0.00%
15.79%
10.53%
5.26%
10.53%
10.53%
5.26%
0.00%
5.26%
21.05%
42.11%
26.32%
36.84%
57.89%
15.79%
47.37%
36.84%
26.32%
Non applicable
No help
Limited help
Some help
A lot of help

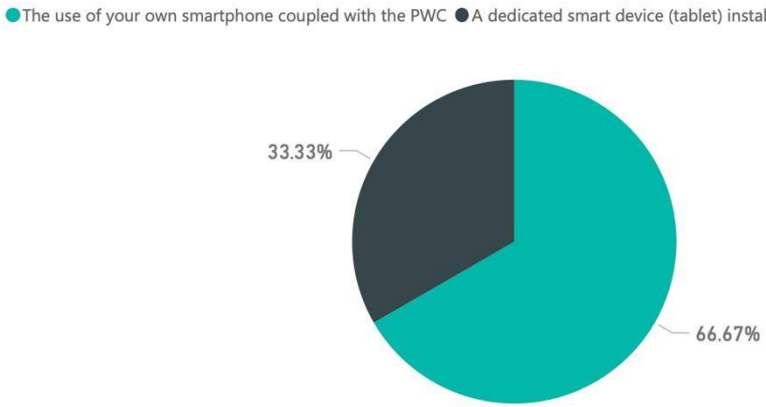

Confidence rate (%)
%GT Cobble stones
%GT Crossing the road
%GT Driving wheel loses contact with the surface
%GT Enter/exit public transports
%GT Going straight on tilted surfaces
%GT Gravel surfaces
50%
40%
30%
20%
10%
0%
15.79%
31.58%
21.05%
15.79%
31.58%
21.05%
15.79%
36.84%
5.26%
21.05%
31.58%
5.26%
21.05%
15.79%
26.32%
15.79%
31.58%
31.58%
42.11%
15.79%
47.37%
42.11%
0.00%
42.11%
5.26%
0.00%
0.00%
5.26%
0.00%
Very confident
Quite confident
Limited confidence
Not confident at all
Non applicable


Required help (%)
%GT Cobble stones2
%GT Crossing the road2
%GT Driving wheel loses contact with the surface2
%GT Enter/exit public transports2
%GT Going straight on tilted surfaces2
%GT Gravel surfaces2
Wh...
No
Yes
60%
40%
20%
0%
5.26%
10.53%
10.53%
5.26%
21.05%
5.79%
0.00%
15.79%
21.05%
21.05%
5.79%
0.53%
5.26%
21.05%
0.53%
36.84%
31.58%
5.79%
36.84%
26.32%
52.63%
15.79%
26.32%
47.37%
26.32%
0.53%
Non applicable
No help
Limited help
Some help
A lot of help


Confidence rate (%)
%GT In a crowd
%GT Kerbs
%GT On the carpet
%GT Paved surfaces
%GT Pot holes in the pavement
%GT Steep hills and slopes
60%
40%
20%
0%
21.05%
31.58%
21.05%
10.53%
21.05%
15.79%
21.05%
31.58%
10.53%
26.32%
31.58%
26.32%
15.79%
31.58%
26.32%
15.79%
21.05%
57.89%
31.58%
0.00%
5.26%
0.00%
5.26%
Very confident
Quite confident
Limited confidence
Not confident at all
Non applicable

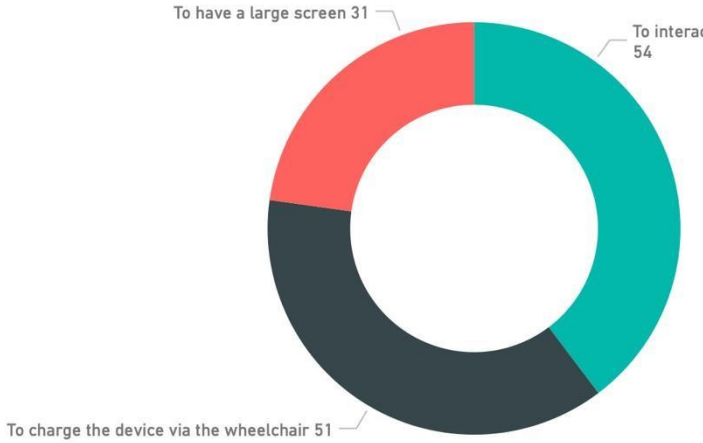

Required help (%)
%GT In a crowd2
%GT Kerbs2
%GT On the carpet2
%GT Paved surfaces2
%GT Pot holes in the pavement2
%GT Steep hills and slopes2
Wh...
No
Yes
60%
40%
20%
0%
5.26%
10.53%
10.53%
5.26%
5.26%
10.53%
21.05%
10.53%
15.79%
0.00%
10.53%
21.05%
10.53%
15.79%
36.84%
31.58%
5.79%
31.58%
36.84%
5.79%
52.63%
42.11%
31.58%
26.32%
31.58%
47.37%
Non applicable
No help
Limited help
Some help
A lot of help

Solution preferred if the new system is partially based on smart technologies (%)

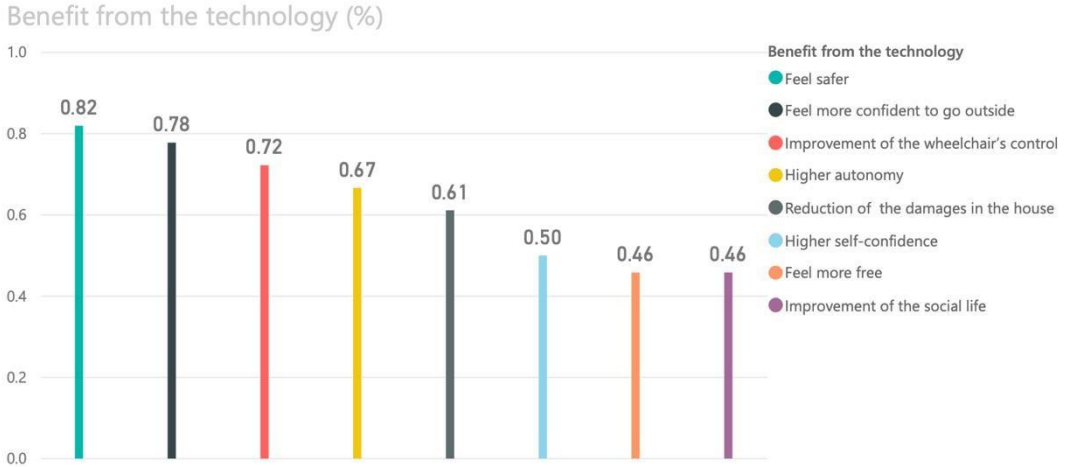


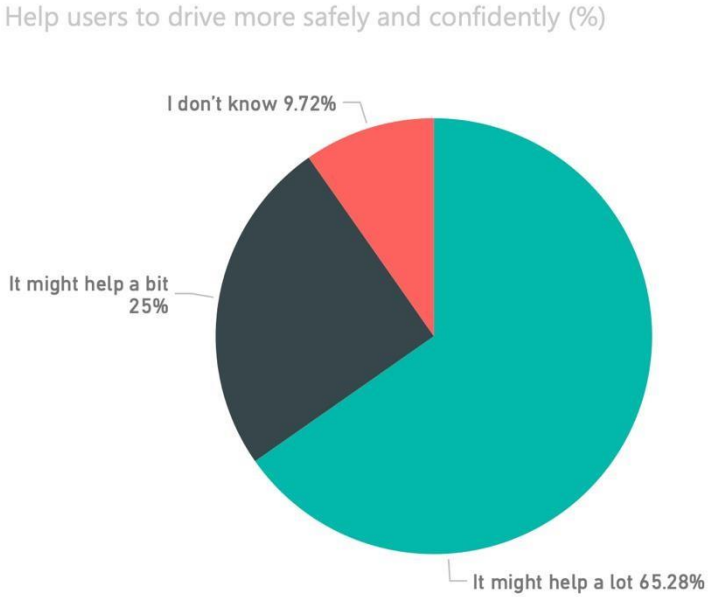
72
N

Important features (abs)



Other features:
- Contrôler le smartphone avec le fauteuil
- Easy using
- BT Communication
- Customizable userinterface (depending on the motoric skills of the user being able to replace buttons or resize buttons
- Simple secure mount/dismount
- Tout dépend de la demande du patient
- Avoir quelque chose d'antichoc
- Hardware buttons
- Functional, but small enough not to get in the way. Possibly a choice of sizes of screens to choose from

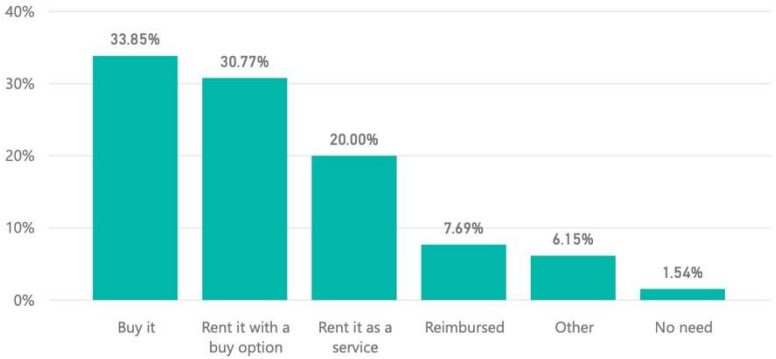




Other benefit from the technology:
- Une meilleure participation sociale, plus d'engagement dans les activités, une reprise des loisirs
- Improvement, more to control, empowered, more available to you to choose or not

72
N

How would you like to acquire the new system ? (%)

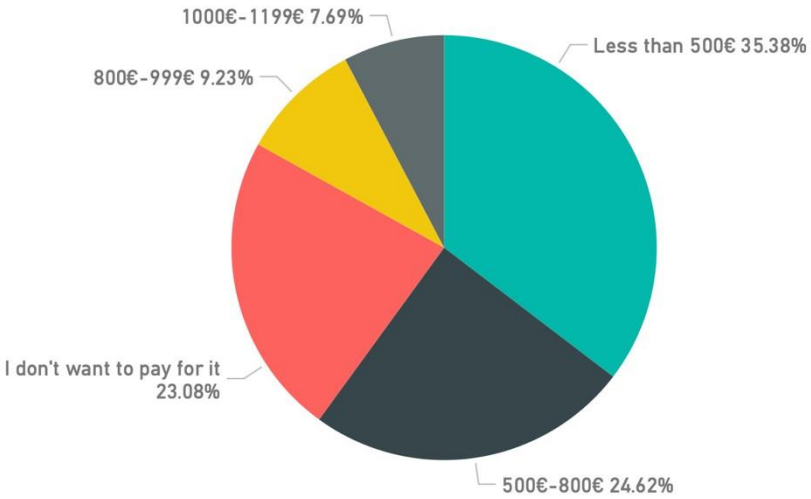


Other way to acquire the system:
- Test it
- Depends upon cost and utility. Option to try before purchase would be helpful. If expensive, then rental with buy option is good.
- Soit à la location, soit à l'achat selon les cas
- Je ne sais pas à priori

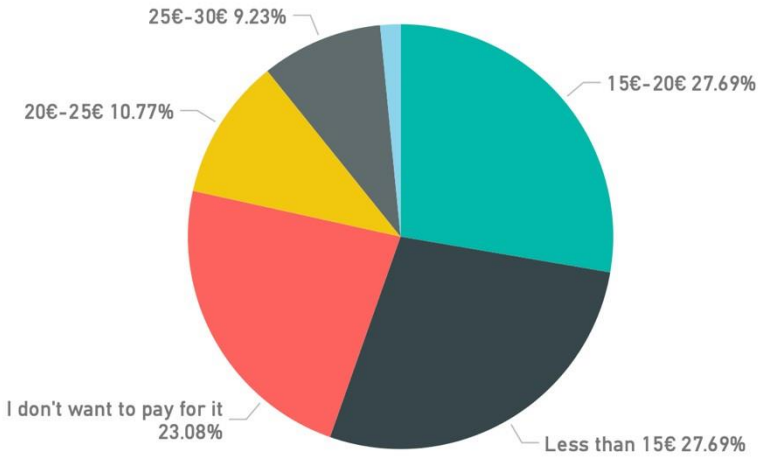
65
N

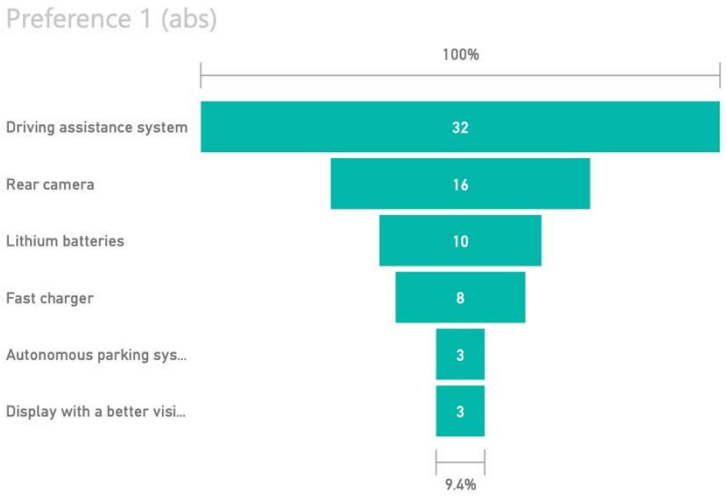
Do you think that adding a driving ...
- Select all
- I don't know
- It might help a bit
- It might help a lot

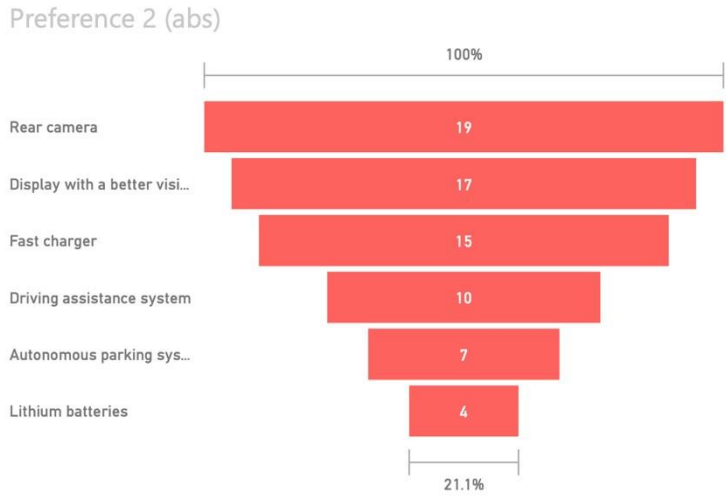
Willingness to pay to buy the product

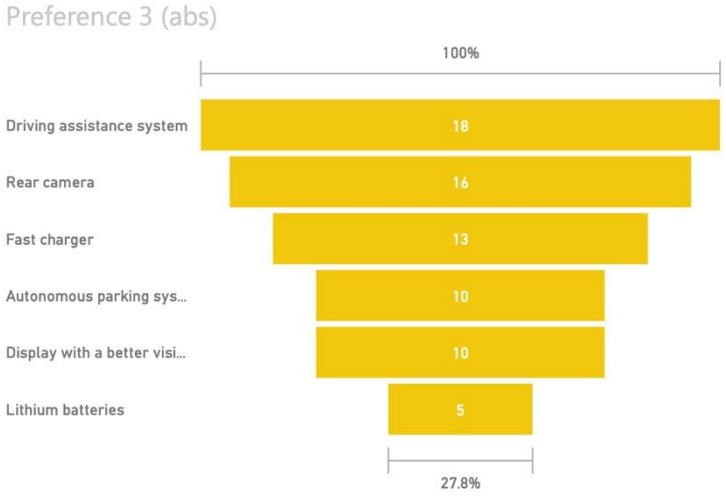


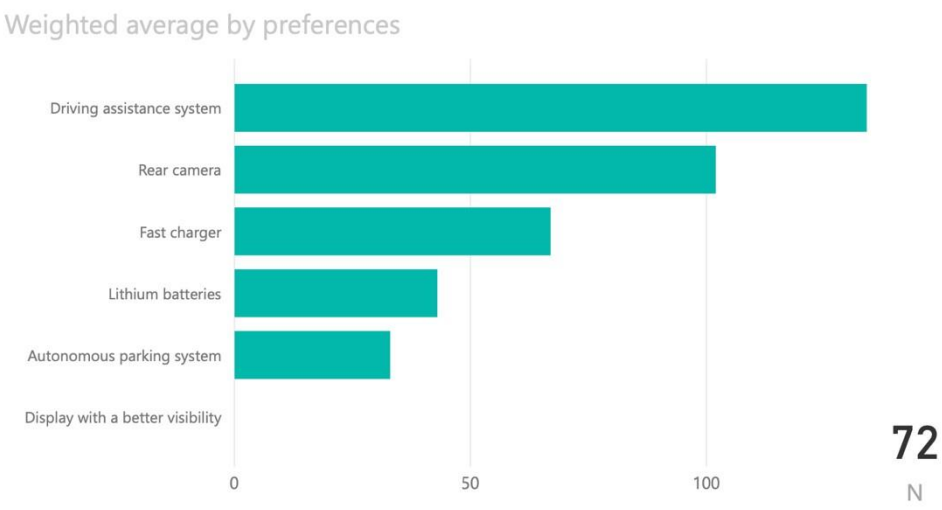
Willingness to pay to rent the product




Preference 1 (abs)
100%
Driving assistance system
32
Rear camera
16
Lithium batteries
10
Fast charger
8
Autonomous parking sys...
3
Display with a better visi...
3
9.4%


Preference 2 (abs)
100%
Rear camera
19
Display with a better visi...
17
Fast charger
15
Driving assistance system
10
Autonomous parking sys...
7
Lithium batteries
4
21.1%


Preference 3 (abs)
100%
Driving assistance system
18
Rear camera
16
Fast charger
13
Autonomous parking sys...
10
Display with a better visi...
10
Lithium batteries
5
27.8%


Weighted average by preferences
Driving assistance system
Rear camera
Fast charger
Lithium batteries
Autonomous parking system
Display with a better visibility
0
50
100
72
N

Do you have any suggestions how driving assistance technologies might help carers and users to drive a PWC more confidently and safely?

- By tracking the cahotic mouvements of the joystick, maybe the system might evaluate the level of help needed by the user. Level of assistance increases as hand tremors become important.

- Avoir une aide à la communication intégrée dans le fauteuil roulant.

- Take the right path at the right moment to reach a goal.

- driving assitance might help in being compatible with special joysticks (head or sensitive)

- to be turn on easily

- Surtout dans les apprentissages

- Permettre l'utilisation de l'assistance à la conduite du fauteuil sur la commande tierce personne ?

- le système d'assistance doit aussi donner à l'utilisateur la possibilité de s'imposer face aux obstacles/ personnes. Son environnement n'est pas obligatoirement prioritaire.

- Couverture pour la pluie

- Een luid alarm systeem die begint te werken als 1) mensen in een menigte te dicht naderen, om te vermijden dat er iemand op je valt en 2) als je achteruit rijdt (zoals vrachtwagens).

- Avoir une IHM qui soit aussi adaptée aux malvoyants

- Ce système d'aide à la conduite peut aider les malvoyants à être plus autonomes avec leur fauteuil à condition que l'utilisation de ce système ne repose pas que sur du visuel !

- Le système d'aide à la conduite peut être une assistance intéressante pour certains types de pathologies (faible mobilité au niveau du tronc et des cervicales). En revanche, il n'est pas plus intéressant qu'une caméra de recul pour des pathologies avec des patients qui ont encore une bonne mobilité au niveau du tronc à mon sens.

- If the device is connected by USB with the wheelchairs for more safely if informations and for charge the device.

- Alerte collision, correction de trajectoire, mémorisation/ sécurisation de trajet à l'extérieur de la maison (GPS adaptatif) pour éviter les trajet compliqués par état des voies.

- Easy to install, light weight, reliable

- It could help to govern speed, braking and latched 'cruise' control. This might make it less tiring and easier concentration for the user.

- It would be useful to have assistive technology input which can be graded and refined for the user, when for example they are learning skills to control their powered wheelchair. Some people who use wheelchairs may not require any of the additional sensory features, others where either developing skills or losing skills could potentially have greater safer independence with the features on than when without.

- For better freedom it should allow to free hands for short times to be able to do 2 handed actions

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