

# Knowledge centre for transport accessibility and mobility of people with special needs using individual means of transport

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**Abstract.** At the Military University of Technology in Faculty of Mechanical Engineering has been established a Knowledge centre for transport accessibility and mobility of people with special needs (PwSN). The main aim of the Centre's activities is to extend issues of universal design and to develop, promote and disseminate innovative product solutions and universal service standards leading to increased mobility and improved road safety for PwSN using individual means of transport. An additional aim is to support teaching staff in preparation for education and in the implementation of training activities in the field of universal design, counteracting the exclusion of PwSN. The activities of the Centre involve the Faculty of Mechanical Engineering, the Institute of Psychology at Cardinal Stefan Wyszyński University and the Motor Transport Institute. The article presents in detail the intentions and expected results of the activities carried out by the Centre. It is assumed that the Centre's activities will make it possible to develop and disseminate original solutions of systems and devices facilitating and supporting the use of individual means of transport by PwSN.

## 1. Introduction

More than a century of dynamic development of the motor vehicle industry has made vehicles of various forms and designs and construction have become a common good and an irreplaceable means of facilitating the movement of people and the transport of goods. Nowadays, the lack of free access to means of transport or its restriction is practically equivalent to exclusion from normal social and economic life and social isolation. The group most vulnerable to discrimination and marginalisation in terms of free and safe movement are people with special needs (PwSN).

According to [1], PwSN are people who, because of their external or internal characteristics or because of the circumstances in which they find themselves, have to take additional measures or apply additional means to overcome a barrier in order to participate in various spheres of life on an equal basis with other people. PwSN are nowadays a very large social group, which will steadily increase in the coming years. This group includes seniors (60/65+ people), people with disabilities (PwD) with permanent or temporary dysfunctions, sick people, people taking medication that prevents them from driving, people with unusual body structures, pregnant women, veterans and road accident victims with post-traumatic stress disorder. All of the above are or will become elderly people (60/65+). In the EU countries (and Poland) we observe a steady increase in the number of the elderly [2]. This is a result of increasing life expectancy and the baby boomers entering retirement age. According to the Central Statistical Office (CSO), at the end of 2020 people aged 60+ constituted about 25% of the population in Poland and it is projected that in 2030 1/3 of the population will be people over 60 years of age, and in 2050 the share

of elderly people in the Polish population may reach 40%. It is also predicted that areas with the highest percentage of people 60+ will be non-urban, away from the agglomerations and relatively sparsely populated, which also have a lower percentage of working age population [3].

For shorter trips, PwSN mainly use individual transport, i.e. bicycles, mopeds, motorbikes and cars. For longer trips they more often use public transport. The main criteria for mode choice are accessibility and safety [4]. Elderly people identify their own car as the best means of transport. The personal car, as opposed to public transport, is familiar to these people, as they have used this means of transport for many years. For many of them it is a symbol of freedom and independence as well as a higher material status and therefore they are reluctant to give it up [5], [6].

Unfortunately, a natural phenomenon accompanying the process of aging of PwSN is deterioration (often significant) of physical and psychomotor efficiency, which causes difficulties with the reception and rapid assessment of information provided by the environment in road traffic and as a result, slows down the reaction to the emerging threats [7], [8]. This makes results in a deterioration of the safety of PwSN actively participating in road traffic and other road users [9]. Nevertheless, with the continuous increase in the offer of different means of transport, PwSN will make more and longer trips in the future, if this offer includes solutions that take into account the specific needs of this group of people [10]. Car drivers will travel more frequently than current elderly drivers - this is especially true for women. Furthermore, it must be assumed that the transport and mobility requirements of PwSN in the future will be much higher than those of the current generation [11]. Thus, ensuring mobility for this group of society is a fundamental condition for creating and maintaining their active and high standard of living. In order to keep up with demographic change and the needs of PwSN, anticipatory measures are needed to increase the mobility of this group of people and at the same time not to deteriorate road safety. One of such actions is the improvement of and adaptation of individual means of transport to specific needs and requirements of PwSN, in effect of using universal design of vehicles and their additional equipment taking into account needs of all their users [12].

The research carried out so far has identified the simplest but important examples of small vehicle adaptations in terms of components such as seats, doors, handles, brackets, supports, steps, knobs, steering wheel or seat belts. Many of these modifications can be made to standard vehicles at little cost and time. These adaptations should increase the overall availability of vehicles for PwSN [13]. At this point, it should be stressed that currently in Poland almost 80% of the passenger cars in operation are vehicles older than 10 years and nothing indicates a change in the age structure of the vehicles in operation in the coming years. Therefore, innovative projects and products facilitating the use of passenger cars by PwSN should also, or perhaps first of all, concern vehicles already in use.

At the Military University of Technology (MUT) in Faculty of Mechanical Engineering (FME) has been established a Knowledge centre for transport accessibility and mobility of PwSN (Centre). This was made possible by obtaining for implementation the project No. POWR.03.05.00-00-CW07/20 co-financed by the European Social Fund under the Operational Programme Knowledge Education Development 2014-2020. The established Centre is the first in Poland operating in the field of transport [14]. It is assumed that the Centre's activities will at least partially contribute to improving the free and safe movement of PwSN in the near and distant future. The article presents the aims, objectives and expected effects of the activities carried out by the Centre.

## **2. The aims and the structure of the Centre**

The main aim of the Centre is to develop, in cooperation with the wider socio-economic environment, issues of universal design and to create, promote and disseminate innovative product solutions and universal service standards leading to increased mobility and improved road safety for PwSN using means of individual transport. The meaning of individual transport are considered to be: cars and vans, motorbikes, mopeds, bicycles and wheelchairs to facilitate the movement of PwSN.

The indirect aim, leading to the achievement of the main aim, is to support the teaching staff of the Military University of Technology (MUT) and Cardinal Stefan Wyszyński University (CSWU) in their preparation for education and in the implementation of training activities in the field of universal design, counteracting the exclusion of PwSN from normal use of individual means of transport.

Three entities are involved in the Centre's activities:

- Military University of Technology (FME) MUT – leader;
- Institute of Psychology (IP) CSWU – partner no. 1;
- Motor Transport Institute (MTI)– partner no. 2.

Establishing a partnership with CSWU and MTI was primarily due to the need to build interdisciplinarity so important in developing issues related to universal design particularly focused on the needs of PwSN. The Faculty of Mechanical Engineering has a large number of research and teaching staff who have professional experience in working with PwD and with organisations working on behalf of PwSN. The department conducts extensive research in the fields of mechanical design innovation, biomedical engineering and road safety. The knowledge and experience of the faculty gained while conducting research on modelling of complex engineering structures, innovative remote-controlled structures, ergonomic assessment of structures, orthoses, biomechanics of human movement, road traffic hazards, safety of drivers and passengers of vehicles, and behaviour of people with disabilities in vehicles will be particularly helpful in the Centre's activities.

The Institute of Psychology conducts extensive research in all fundamental areas of psychology. The experience gained in conducting research on building mathematical models of psychological processes, psychometric analyses, cognitive processes (e.g. perception, memory, etc.) and the effects of medication and fatigue on cognitive functioning will be used in the Centre's activities.

Motor Transport Institute (MTI) occupies a high position as a leading scientific-research institution in Poland in the field of motor transport. The Polish Road Traffic Safety Observatory operates at MTI. People with musculoskeletal dysfunctions occupy an important place in the Institute's research activity. As a result of the work carried out by MTI, in 2015 the Centre for Automotive Services (CAS) for People with Disabilities at MTI was opened - the first institution in Poland to provide a comprehensive mobility support system for people with mobility impairments.

All activities conducted by the Centre will be implemented by interdisciplinary teams consisting of representatives of each of the above mentioned entities. In the work of the Centre participate 52 people (29 people from FME, 12 people from IP, 7 people from MTI and 4 external experts). These people are organised in 7 teams.

### **3. Activities carried out by the Centre**

It is assumed that the activities carried out by the Centre will, at least in part, contribute to solving the important problems facing our society in the future in relation to transport and mobility of PwSN. The Centre's activities will be multi-pronged.

The first will be technical support for the design and production of devices and components to adapt vehicles under development, in production or already in use to the needs and requirements of people with special needs. The development of innovative vehicle systems and equipment in the context of the needs of users with special needs should be aimed at:

- practicality, comfort and ease of use of the vehicle (in particular, ease of getting on, off and moving within the vehicle, ease of packing and unpacking luggage) ease of boarding, alighting and moving about inside the vehicle, ease of packing and unpacking luggage) and ease of use of all equipment used in the vehicle;
- safety in road traffic, in pedestrian, bicycle and other traffic lanes (in particular: introduction of devices warning against traffic hazards and systems assisting the driver in difficult road manoeuvres).

In order for this to be effectively realised, it is necessary to adequately prepare academic research and teaching staff who, themselves fully informed, will be able to pass on to students - future and current engineers and designers - a sensitivity to PwSN problems together with the principles of universal design.

The second measure will be showing the problems of PwSN widely known to the public and to raise awareness that manual dexterity, responsiveness to external stimuli and decision-making decrease with age. Improving this awareness among the target group and decision-makers at various levels, which is a long-term process, should lead to creating demand for products and services resulting from the first measure. Another social aspect will be the provision of reliable knowledge resulting from analyses and

research, which will facilitate individual decision-making for the people concerned (regarding research, training, equipment purchases), and for decision-makers in creating policies and long-term social programmes. These activities must be supported by PwSN education to raise awareness of road traffic risks.

The third activity will be the coordinated, systematic research and analysis of the introduced technical and technological improvements, quality of service standards and their verification in terms of their usefulness and effectiveness in reducing adverse road incidents involving PwSN. Information on both useful and unhelpful solutions should be published along with reliable justification, preferably confirmed by industry authorities. The process approach, in a longer perspective, has a chance to create high quality expertise, which should translate into public confidence. It is also important that verified knowledge in this area is regularly updated and concentrated in one place to facilitate access to it by all interested parties.

In particular, the Centre's activities will consist in:

- 1) acquiring, collecting, analysing, developing, exchanging and making available (to all stakeholders) knowledge covering the problems and barriers related to the mobility of PwSN using means of personal transport;
- 2) to develop, update and promote universal design standards in the field of transport and mobility for PwSN, with particular reference to ergonomics and methods of selection of vehicle control aids and adaptive devices;
- 3) provide psychological and therapeutic support to PwSN in the context of their mobility and transport;
- 4) analysing PwSN transport and mobility regulations and legislation and proposing legislative amendments;
- 5) conducting surveys of PwSN on current topics developed by the Centre's teams;
- 6) monitoring the usefulness and effectiveness of new systems and equipment in vehicles in the context of the needs of their users with special needs;
- 7) organising national competitions for proposals and concepts of devices, objects and services to improve mobility and road safety of PwSN;
- 8) developing project concepts for innovative products and service standards friendly to PwSN in the area of transport;
- 9) preparing own curricula and providing opinions on other curricula for teaching staff, students, volunteers and other people and institutions interested in universal transport design;
- 10) preparation of training courses for the teaching staff of FME and IP;
- 11) giving opinions on documents concerning special needs and requirements of PwSN;
- 12) initiating cooperation with social and economic organisations working for the benefit of PwSN;
- 13) international cooperation in order to exchange information and best practices in the field of universal design and mobility support for PwSN;
- 14) organising and participating in conferences, seminars, and scientific and training workshops devoted to the promotion and development of universal design in the field of transport and mobility of PwSN;
- 15) creation of the Centre's website and its ongoing updating with current and important information on the research conducted by the Centre and the results obtained;
- 16) running two information and consultation points (one each in FME and MTI) supporting and advising individuals and socio-economic organisations cooperating with PwSN, as well as mediating in direct contacts with the Centre's specialists.

#### **4. Expected results of the Centre's activities**

As a result of the work carried out by the Centre:

1. Six original scientific studies will be created:
  - an analysis of the difficulties and problems of PwSN in movement related to transport and mobility;
  - a catalogue of special needs relevant to the transport and mobility of PwSN;

- universal design standards in the field of transport and mobility with particular reference to ergonomics and methods of selecting adaptive equipment;
  - an analysis of the legislation in the field of PwSN transport and mobility and recommendations for legislative changes;
  - guidelines for psychological and therapeutic support for PwSN in the context of transport and mobility;
  - an analysis of the effectiveness of new in-vehicle systems and devices introduced in the context of the needs of users with special needs.
2. Cooperation with external experts and with the socio-economic environment related to transport and mobility of PwSN will be established and developed in order to carry out research and development work for the benefit of PwSN (including soldiers and war veterans with disabilities) and entrepreneurs producing vehicles and equipment for PwSN.
  3. Model training programmes will be developed for academic staff of FME and IP to prepare for teaching students of universal design focused on the transport and mobility of PwSN using individual means of transport. The training programmes will be developed in cooperation with the socio-economic environment, including the use of knowledge and experience of leading experts from Polish and foreign universities.
  4. Model curricula for six specialised training courses will be developed. These will be addressed to PwSN, volunteers and organisations servicing and cooperating with PwSN, as well as to economic entities involved in the design, production and adaptation of vehicles and their equipment to the needs of PwSN.
  5. Curricula for selected courses of studies of the first and second degree conducted at FME and for uniform master's studies conducted at the faculty of Psychology will be modified. The curricula will be supplemented with new subjects promoting knowledge of accessibility and universal design in transport and mobility of PwSN. Information sheets on the new subjects will be developed separately for FME and IP.
  6. A nationwide pilot competition will be held for innovative proposals and concepts for devices, objects and services to improve mobility and road safety for people with special needs using personal transport. The competition will be aimed at students and teachers of secondary vocational schools and student research clubs at universities and technical colleges. The goal of the competition is to identify innovative ideas and concepts of solutions supporting mobility and safe transport of PwSN, which will be a source of inspiration for the Centre's project team and other entities cooperating with PwSN. It is assumed that the competition will be held periodically.
  7. At least 10 innovative product concepts and standards for services supporting transport and mobility of PwSN will be developed.
  8. The competences of 50 academic staff members of FME and IP will be improved in the field of universal design principles in two six-day training cycles (one each for FME and IP).
  9. Twelve specialist trainings will be carried out on the basis of previously prepared programmes (2 trainings per one subject). It is assumed that over 120 people will participate in specialist training courses.
  10. Part of the building of the Institute of Vehicles and Transport (FME) and its immediate surroundings will be reconstructed in order to adapt them to the needs of the disabled. The part of the building adapted to the needs of the Centre's stakeholders will house the Centre's secretariat, information and consultation point, toilets and a didactic laboratory for teaching universal design. The laboratory will be equipped with specialised apparatus (driving simulator, elderly simulators, demonstrators of driving systems for people with different dysfunctions, semi-active and active wheelchairs, etc.). The laboratory will be equipped with new apparatus as the Centre develops.
  11. Two information and consultation points will be established (run by PwD with extensive knowledge and experience) aimed at helping PwSN and organisations cooperating with them. The activities of the consultants will be supported by four substantive advisors of seven MTI

specialists, whose knowledge and experience has been consolidated while participating in the work of the Motor Service Centre. The consulting points will operate also after project completion.

All products developed and produced as part of the Centre's activities will be publicly available (e.g. on the Centre's website [14]) and can be reviewed, analysed, discussed and, as a result of information exchange, improved and used by external entities. It is assumed that the Centre's activities will become a permanent feature on the map of Poland.

## 5. Summary

It is assumed that the activities of the Centre described in the article will make it possible to develop, promote and disseminate innovative solutions for systems, products and universal service standards facilitating and supporting the use of vehicles by PwSN. As a result, PwSN will remain mobile and road safety will not deteriorate.

Currently, many devices and systems for driver assistance are being developed, but without a clear focus on the PwSN. Therefore, it is high time to design user-friendly vehicles and equipment. Recommended actions are:

- improving simple and advanced systems of driving support by including PwSN in the process of vehicle and road use and design;
- introducing a procedure for testing new road infrastructure solutions and new vehicle technologies with the participation of PwSN;
- educating PwSN to raise awareness of the road traffic risks arising from the limitations of their physical and mental fitness and information on the benefits and use of systems supporting vehicle users.

Transport is the second area, besides architecture, that is reported by PwSN area as requiring immediate improvement in terms of accessibility. Comments made during the public consultation on the Accessibility Plus Programme pointed to the risk of marginalisation, through all kinds of barriers to access of transport and mobility, which are the basis for the functioning of a modern society. In terms of accessibility of transport, a lot is changing for better, but most of the actions so far have concerned of transport and the environment of public transport.

The Centre's activities described in this article relate to means of transport. It demonstrates the originality and innovation of the Centre's activities.

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