Institute of Transport Economics
Norwegian Centre for Transport Research

Universal design in transport

Editors: Nils Fearnley and Kjersti Visnes Øksenholt

Preface

The current literature on universal design has so far failed to fully address the challenges faced by transport agencies, and when the planners lack holistic knowledge, the solutions that are developed will not meet the required standard.

The aim of this collection of articles is to contribute to increased overall knowledge about what universal design and accessibility for all entails, and also the principles of how accessibility for all can be achieved in a transport context in terms of the planning process and physical solutions. In this way, the articles will contribute to the realisation of universal design, and thus promote a better quality of life and equality for people with disabilities.

The collection of articles is a topical reference work on universal design for various study programmes, fields of study and postgraduate courses in the higher education sector, and for transport agencies and planning authorities.

We would like to extend a big thank you to Liv Øvstedal and Stein Brembu at the Norwegian Public Roads Administration, who initiated and partly funded the articles, and to the Norwegian Directorate for Children, Youth and Family Affairs (Bufdir) who partly funded the collection through their grant scheme 'Universal design – knowledge development, skills development and information'. A big thank you also to Tanu Priya Uteng from the Institute of Transport Economics (TØI) who took on the role of substitute editor for the first article in the collection, which was written by the editors. And thank you very much to Hanne Sparre-Enger from the TØI's Department of Communication, who edited the texts and led the work on layout and design.

Finally, we would like to thank the anonymous reviewers who have peer reviewed all the contributions. The authors and editors agree that their close reading and thorough feedback have greatly improved the articles.

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A collection of articles: Universal design in the transport sector

The aim of this collection of articles is to contribute to increased knowledge about what universal design and accessibility for all entails, as well as principles of how accessibility for all can be achieved in a transport context in terms of both the planning process and physical solutions. We want the collection to strengthen universal design, and in turn contribute to a better quality of life and equality for people with disabilities.

The collection is comprised of seven articles, where this introductory article is Article 1. All shed light on various aspects of universal design in the transport sector.

Article 2. **'Functional requirements for inclusive transport'**, discusses the functional requirements that transport solutions must satisfy in order to facilitate social inclusion of people with disabilities (Bjerkan, 2022).

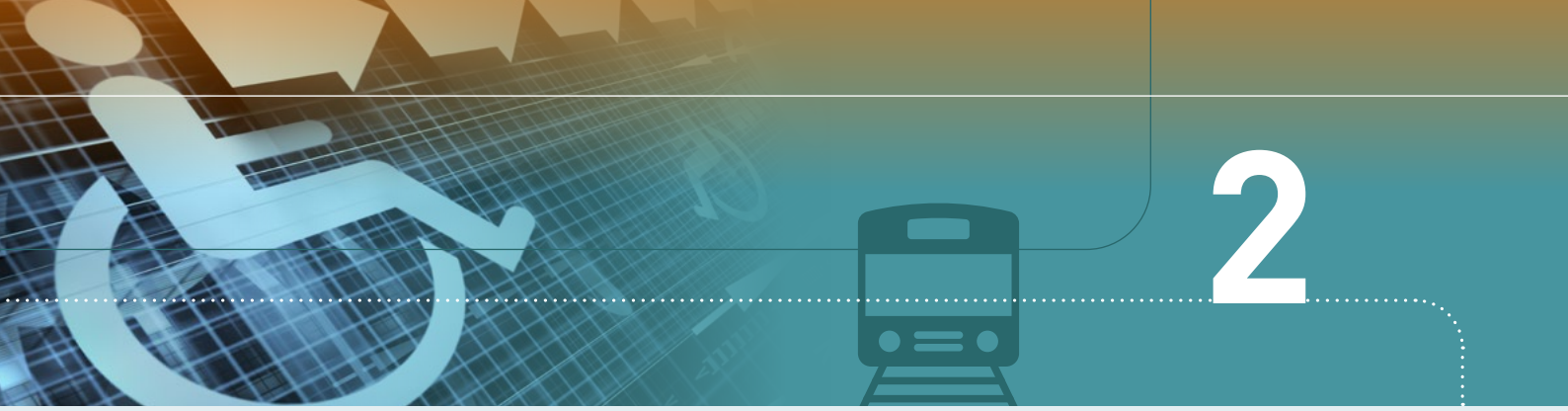
Article 3, **'Universal design and barriers to using public transport**, aims to deepen the understanding of how the transport system is perceived by different groups of people, and to understand and foresee challenges, weigh up the various issues, and facilitate good solutions that benefit as many people as possible (Nielsen and Øksenholt, 2022).

Article 4, **'Universal design and public participation in planning processes**', discusses how universal design can be better safeguarded in the planning process. The article aims to deepen the understanding of the complexity of the planning system, and how this can act as a hindrance for good and holistic solutions (Sjøstrøm et al., 2022).

Article 5, **'How can we ensure universal design of trip chains in a system with complex laws, regulations and responsibilities?'**, gives the reader an introduction to the statutory and organisational framework for universal design in the transport sector, with a particular focus on trip chains. The article discusses how to safeguard universal design of the transport system in a context where legislation and accountability are complex, and reforms alter the distribution of responsibility (Øksenholt and Krogstad, 2022).

Article 6, **'Effects of universal design: quality of life, demand and socioeconomic benefit'**, shows how the utility of universal design for passengers can be measured, and thus also used in cost-benefit analysis, which surprisingly often show that universal design measures in public transport are highly efficient, i.e. they improve social welfare because benefits exceed costs (Fearnley, Veisten and Nielsen, 2022).

Article 7, '**Transport solutions of the future: technology, design and innovation**, describes a selection of new and future transport solutions that are of particular relevance in Norway, and discusses these in the context of what we know about the needs of various user groups. The article demonstrates how new transport solutions are multifaceted and affect the various user groups in different ways (Aarhaug, 2022).



2

Functional requirements for inclusive transport

KRISTIN YSTMARK BJERKAN

Mobility is an important aspect of our lives, and the opportunity to move from place to place as we wish is a prerequisite for participating in a number of arenas. If such participation is limited due to insufficient or inaccessible transport, we call this mobility-related exclusion. In particular, such exclusion can explain the marginalisation of people with disabilities. This chapter will therefore discuss the functional requirements that need to be met if transport solutions should facilitate social inclusion of people with disabilities.

The article is based on Bjerkan, K.Y. & L.R. Øvstedal (2018) Functional Requirements for Inclusive Transport, *Transportation*, Vol 40, No. 5, pp. 1–22. The original article has slightly modified and complemented with a new section 4: 'Implications for transport providers'. The original version can be found here.

Kristin Ystmark Bjerkan

Kristin Ystmark Bjerkan is Research Manager at SINTEF, Department of Mobility. Her research includes the role transport in shaping the living conditions and social participation of people with disabilities, hereunder the role of transport in education and employment.

1. Introduction

Despite the political focus in recent decades on the low participation of people with disabilities in economic, social and civic life, this remains a marginalised group. Research has regarded this marginalised position as a result of social exclusion and a lack of facilitation for broad economic and social participation, which are fundamental for acting as full members of society (Bhalla and Lapeyre, 1997, Lee and Murie, 1999, Levitas et al., 2007, Nussbaum, 2011, Sen, 2000).

Transport is one factor that impacts exclusion, and characteristics of transport systems, modes of transport and transport services can contribute to what is described as mobility-related exclusion. Kellerman (2006) describes mobility as the ability to move between different locations, the freedom to move from one place to another as one wishes, and as something that comprises both actual and potential journeys. He refers to mobility as a social construct, and claims that mobility and control over one's own mobility both reflect and reinforce power. Mobility can also be regarded as a fundamental human right (Farrington, 2007, Imrie, 2000, Kellerman, 2006).

Mobility is the ability to move between different locations, the freedom to move from one place to another as one wishes, and something that comprises both actual and potential journeys.

This study presents trends in empirical research into transport and disability. The study has posed the question: **What functional requirements should a transport solution meet to facilitate social inclusion of people with disabilities?** Transport solutions include: i) ordinary public transport and mobility services (including taxis); ii) transport support schemes that are administrated by public agencies (e.g. facilitated transport services, travel in connection with employment and education, grants for cars, convalescence travel, etc.); and iii) personal modes of transport (e.g. private cars, bicycles, walking).

In the following, **'transport solution'** will be used as a collective term for the above, and will be used to highlight the relevance of the functional requirements irrespective of the type of transport in question.

'What functional requirements should a transport solution meet to facilitate social inclusion of people with disabilities?'

The study describes eight functional requirements that should be met by transport solutions if they are to promote social inclusion.

- asily accessible information
- Flexibility
- Safety and security
- Universal design
- Reliability
- Economic predictability
- Minimised administration
- Short, predictable travel times

The proposed functional requirements are based on a review of existing literature and build on the definition of disability in the International Classification of Functioning, Disability and Health: 'Disability is an umbrella term for impairments, activity limitations and participation restrictions. It denotes the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors)' (WHO 2013).

The study also discusses how these functional requirements can facilitate inclusion and how transport service providers can address these requirements in practice.

1.1 Social exclusion and transport

Historically, research on social inclusion has not included transport (Hine and Mitchell, 2001). Burchardt et al. (1999) identify five types of activity that describe social inclusion.

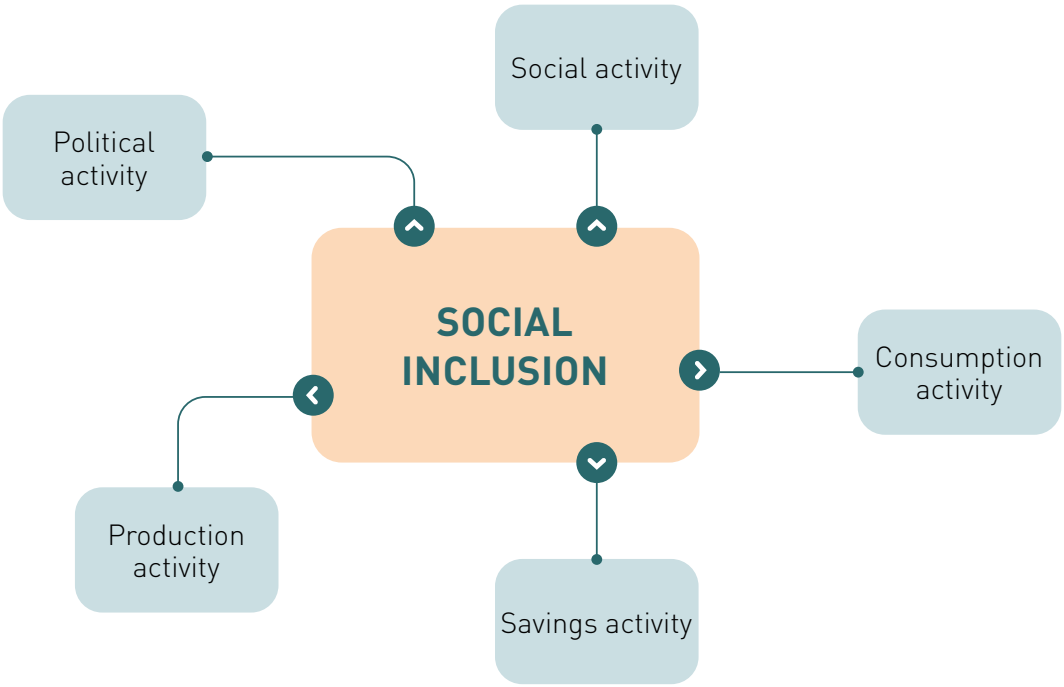
Consumption activity is the ability to buy and take into use a minimum level of goods and services considered normal in a given society.

Savings activity is the ability to accumulate assets (e.g. savings, property) and rights that can unlock assets (e.g. a pension), which secures an individual's prosperity even if they exit the labour force.

Production activity is the ability to take economic and/or socially valued activity that contributes to self-respect.

Political activity is to engage in the social or physical environment, such as voting or joining political parties.

Social activity refers to engaging in social interaction with family or friends, and identifying with a cultural group or community.



Although transport has not been considered an independent dimension of social inclusion, the *lack of transport adaptation* has been linked to other dimensions of social inclusion (Wixey et al., 2005). Kenyon et al. (2002) define mobility-related exclusion as the process by which people are prevented from participating in the economic, political, and social life of the community because of reduced accessibility to opportunities, services, and social networks, due in whole or in part to insufficient mobility in a society and environment built around the assumption of high mobility.

'Mobility-related exclusion arises when insufficient or inaccessible transport prevents participation.'

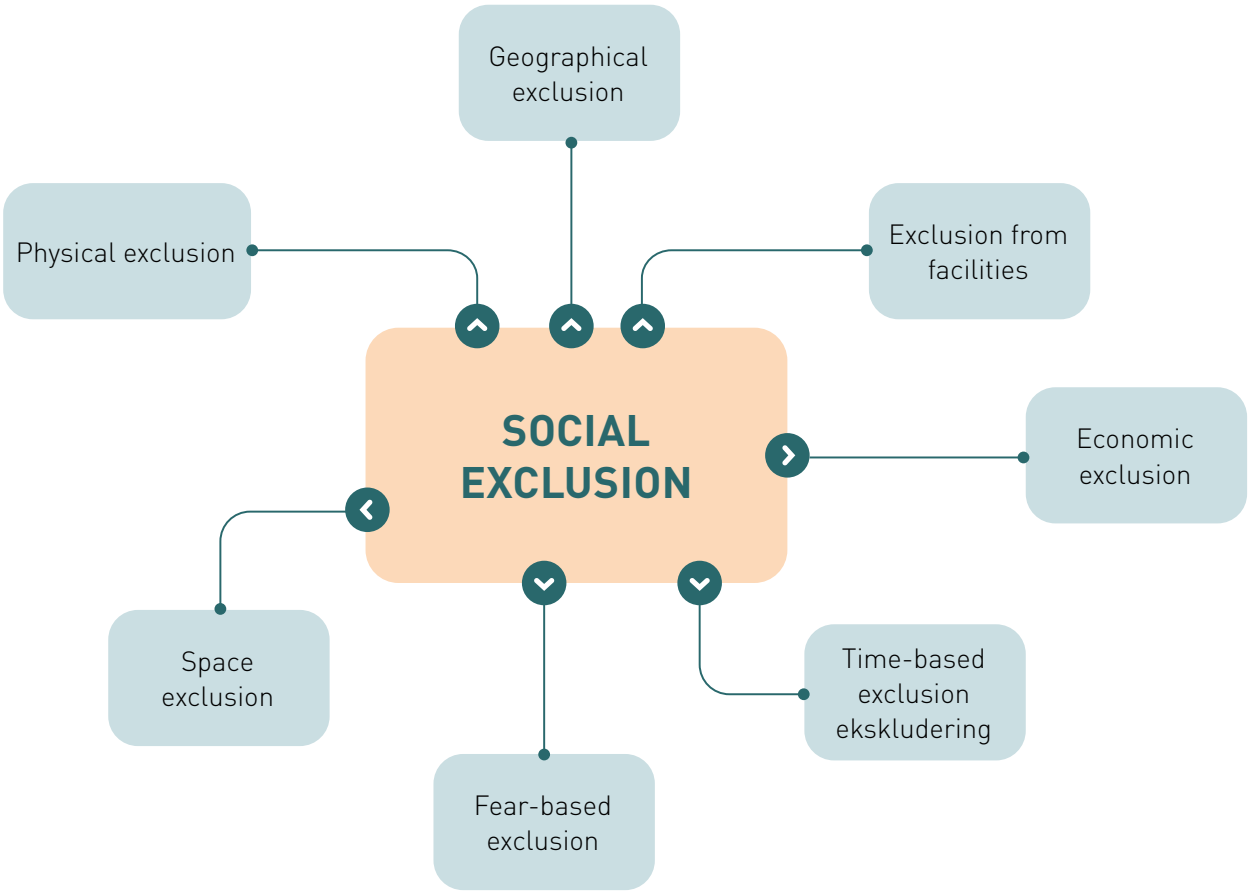
However, the relationship between transport and social inclusion is multifaceted, and the literature includes different understandings of how transport strengthens or weakens inclusion. According to Schwanen et all. (2015), inadequate transport provision is a result of i) a lack of resources, ii) a lack of knowledge, iii) dependence on others to enable travel, and iv) a lack of influence on transport policy and decision-making.

Kaufmann (2002) presents similar understandings and relates mobility-related social exclusion to the concept 'motility'. Motility is a product of the interactions between i) travel alternatives and the limitation of these (in terms of time, space, monetary income), ii) the individual's ability to recognise and exploit opportunities, and iii) the individual's stated demands for transport. Thus, Kaufman emphasises the significance of the resources and capital of individuals.

Stanley and Lucas (2008) present another approach to mobility-related exclusion and link mobility to three basic human needs: capability, relatedness, and autonomy. They conclude that increased mobility and upgraded transport solutions have considerable value in terms of preventing social exclusion among at-risk groups.

'Increased mobility and upgraded transport solutions have considerable value in terms of preventing social exclusion among at-risk groups.'

Church et al. (2000) expand on the relationship between exclusion and mobility, and propose seven types of exclusion linked to mobility. **Physical exclusion** refers to characteristics of the transport system and built environment that inhibit access and create physical and/or psychological barriers. These can affect participation for young children, older adults, and people with disabilities etc. **Geographical exclusion** refers to ways in which insufficient transport services can exclude people from social arenas, while **exclusion from facilities** refers to the fact that the distance between individuals and the services they need (education, health services, public services, shopping, leisure) is of vital importance (see Burchardt et al.,1999). **Economic exclusion** refers to an inability to bear financial or time-related transport costs (the journey takes too long), something which reduces the number of transport alternatives an individual can choose from. While **time-based exclusion** occurs when responsibility and activities limit the time available for travel, **fear-based exclusion** occurs when fear and worry limit travel choices. Finally, **space exclusion** refers to persons being prevented from using public spaces due to the design, surveillance, and management of these spaces.



1.2 Transport, disability and participation

As we have seen, mobility-related social exclusion occurs in the interplay between individual characteristics, the characteristics of local areas, and characteristics of the national and/or global economy (Lucas, 2012). Disability is also closely linked to such exclusion. A limited transport service reduces access to the labour market, financial services, education and training, health services, grocery shopping and participation in social, cultural, political, and religious activities (Wixey et al., 2005). It is therefore important to understand the link between the transport solutions and access to services and facilities (Rosenbloom, 2007). A number of empirical studies have pointed to the relationship between transport and participation among people with disabilities (Bodde and Seo, 2009, French and Hainsworth, 2001, Reynolds, 2002, Rimmer et al., 2004, Shields et al., 2012, Smith et al., 2015). However, few studies make explicit attempts to understand how participation is affected by specific barriers in the travel chain.

2. Data and method

The aim of this study is to map empirical research that identifies transport barriers and to use this literature to propose a set of general functional requirements for inclusive transport solutions. Such functional requirements can be useful for assessing whether a specific transport solution can be expected to facilitate participation and social inclusion.

2.1 Scope

The literature review includes empirical studies investigating barriers to the use of transport among people with disabilities. The review is limited to publications in English and the Scandinavian languages published between 2000 and 2017. Relevant studies were identified through literature searches in Web of Science and Google Scholar. The following search terms were used:

- Transport* AND barrier*
- Transport* AND barrier* AND disabilit*
- Transport* AND disabilit*

Some of the literature was also identified through the authors' personal knowledge as well as input from colleagues in the field of transport and disability. Relevant literature was also identified via the snowball sampling method (Goodman, 1961), which involves identifying new sources in the reference lists from studies that are already included in the review.

The searches generated a large number of studies, and these were included in the literature review if they presented empirical research findings on transport and people with disabilities. The search also generated studies that were not considered relevant. The majority of the search results on Web of Science and Google Scholar were linked to medical research and engineering fields and were therefore not included.

Some of the studies in the literature review focus on older people with disabilities. There are also a number of studies on (barriers to) using transport among older people in general. Even though there is a certain correlation between age and disability, studies of older people and transport were not included unless there was an explicit focus on disability.

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Publications that only indirectly dealt with transport were also excluded from the literature review. This particularly related to articles focusing on general barriers to participation, where transport can be one factor. Unless these included empirical data on mobility-related barriers they were excluded.

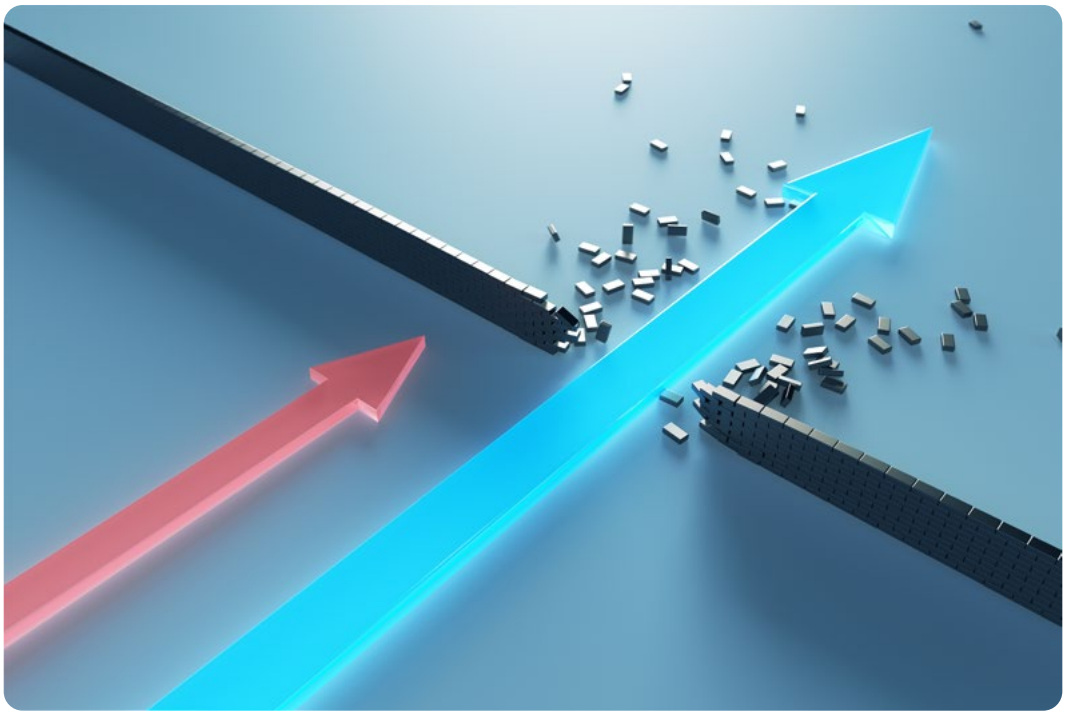
2.2 Identification of functional requirements

The functional requirements are identified based on the empirical results from the studies included in the literature review. The literature was analysed through conventional content analysis (Hsieh and Shannon, 2005) and data coding (Charmaz, 2006).

Firstly, all studies that included empirical research findings on transport and people with disabilities were identified. Then we identified those that presented empirical findings on i) barriers, difficulties or problems with transport, and/or ii) conditions, solutions or examples of how transport can be made accessible. A thorough reading of these provided the basis for categorising (coding) factors that hinder (barriers) and promote (conditions) the use of transport among people with disabilities. The mapping also included the reasons for barriers and challenges, and how they can be reduced.

The categorisation of barriers and conditions was then used to define problem descriptions, i.e. descriptions of barriers, reasons for and potential solutions to the use of transport solutions among people with disabilities.

The functional requirements were defined as a response to these problem descriptions. The problem descriptions and functional requirements were continually revised as new studies were included, however the revisions were only minor.



2.3 Studies in the literature review

A total of 33 studies were included in the literature review (Table 1), and these are mainly from Scandinavia (15), the USA (9) and the UK (5). The remainder are from Australia, the Netherlands and Croatia.

The majority of the studies investigate specific transport barriers experienced by people with disabilities. Some focus on a particular type of disability: autism (3), cognitive and developmental disabilities (3) and physical disabilities (3). The rest focus on transport support schemes aimed at people with disabilities and the use of public transport in general.

Around half the studies deal with public transport (18), while eight look at support schemes aimed at people with disabilities. A considerable proportion (10) investigate general transport barriers, for example linked to leisure travel or as part of travel surveys. Three studies investigate barriers linked to the use of private cars.

Many studies use method triangulation. The majority of the studies have nevertheless used surveys (20) or interviews (18). Some studies (6) use other qualitative methods, for example participatory observation and co-travelling.

Table 1 gives an overview of which studies support the various functional requirements presented in the next chapter, where 1 = Accessible, centralised information, 2 = Flexibility, 3 = Safety and security, 4 = Physically accessible design, 5 = Reliability, 6 = Economic predictability, 7 = Minimised administration and 8 = Short, predictable travel times.

Year	Author(s)	Country	Publication type	Functional requirements
2017	Bezyak et al.	USA	Journal article	2,3,4,5,8
2016	Deka et al.	USA	Journal article	2,4
2016	Lubin & Feeley	USA	Journal article	1,2,3
2016	Nordbakke & Skollerud	Norway	Report	1,2,4
2016	Verbich & El-Geneidy	UK	Journal article	1,8
2015	Babic & Dowling	Croatia	Journal article	2,4
2015	Falkmer et al.	Australia	Journal article	3
2014	Leiren	Norway	Report	2,3,5
2013	Bjerkan et al.	Norway	Journal article	2,4,6,7
2012	Deloitte	Norway	Report	5
2012	Lubin & Deka	USA	Journal article	1,6,7
2012	Rambøll	Norway	Report	2,3,7
2012	Risser et al.	Sweden	Journal article	1,3,4
2012	Solvoll & Anvik	Norway	Report	2,5,6
2011	Aarhaug et al.	Norway	Report	1,3,4,5,6
2011	Delbosc & Currie	Australia	Journal article	1,2,5
2011	Nordbakke	Norway	Report	4,6
2009	Bjerkan	Norway	Report	4
2009	Buffart et al.	Netherlands	Journal article	5,6
2009	Nordbakke & Hansson	Norway, Sweden	Report	2,5,8
2009	Rosenkvist et al.	Sweden	Journal article	3
2008	Penfold et al.	UK	Report	2,4
2007	Wasfi et al.	USA	Conference	1,2
2005	Voorhees & Bloustein	USA	Report	1,2,3,4,5,7,8
2005	Daniels et al.	USA	Journal article	3,4
2004	Gladwell & Bedini	USA	Journal article	6
2004	Logan et al.	UK	Journal article	1,3
2002	Carlsson	Sweden	Thesis	3,4
2001	Beart et al.	UK	Journal article	1,5
2001	Grut & Kvam	Norway	Report	1,2,4,5,7,8
2001	Lodden	Norway	Report	4
2001	The London Transport Users Committee	UK	Report	4
2000	Denson 2000	USA	Journal article	5

Table 1. Studies included in the literature review.

3. Functional requirements

The studies in the literature review are mostly in agreement about what is needed for transport solutions to be accessible and user-friendly for people with disabilities. Below we present eight functional requirements that a given transport solution should meet to be a realistic alternative for people with disabilities, and thus facilitate social inclusion.

The table below provides key words linked to each functional requirement (FR). The requirements are relevant for most social and cultural contexts. However, the conditions for implementing and complying with such requirements may vary between transport and mobility systems with different socio-cultural environments. How prominent or critical a functional requirement is can also vary between countries and regions. The functional requirements are exclusively aimed at the transport solution and are independent of the individual travellers. Nevertheless, the importance of the different requirements can vary depending on the individual and the situation in question. The requirements are presented in line with their prominence in the literature review.

FR1 Accessible centralised information

- easy to find
- single information point
- real-time information
- information on universal design
- universally designed information
- grant criteria and discounts

FR2 Flexibility

- when and where can the transport solution be used
- for which purposes can the transport solution be used
- sufficient capacity/can the services be used now
- change of destination/purpose/timing of service
- choosing between transport solutions

FR3 Safety and security

- physical safety
- anxiety and fear
- self-awareness
- driver skill and characteristics

FR4 Physically accessible design

- boarding and alighting
- to and from stops on
- board
- stop
- reserved parking

FR5 Reliability

- punctuality
- unforeseen events
- access to assistance
- budgeting
- application processing

FR6 Economic predictability

- out-of-pocket expenses and fares
- predictable support schemes

FR7 Minimised administration

- many different support schemes
- challenging application processes
- planning own journeys

FR8 Short, predictable travel times

- effective transport solutions
- coordination of support schemes

Table 2. Keywords linked to the functional requirements.

1 Accessible, centralised information

This functional requirement is about making necessary information easily accessible, and a number of studies show that it can be difficult to find information about particular transport solutions (Aarhaug et al., 2011, Delbosc and Currie, 2011, Lubin and Deka, 2012). It is vital to provide information about all transport solutions that are available for travellers, since many people are simply not aware of the transport alternatives that are available to them (Beart et al., 2001, Grut and Kvam, 2001, Logan et al., 2004). Information is also important when planning a journey (Nordbakke and Skollerud, 2016) in terms of practical preparations, but also in terms of mental preparation such as building self-confidence about being able to cope with the journey. Travellers should, for example, have information about whether the vehicle will be universally designed before they start their travel, so that travellers with a disability can assess what type of assistance they may need during the journey (Aarhaug et al., 2011, Voorhees and Bloustein, 2005).

Lubin and Feeley (2016) emphasise the need for real-time information about the arrival of the vehicle, in particular for users of transport support schemes. Other studies point out that the information must be accessible and easy to understand at stops and stations (Verbich and El-Geneidy, 2016) and during the journey (Risser et al., 2012, Wasfi et al., 2017).

It is important for existing and potential users that information about the transport solution is easy to understand, relevant and easy to find (see e.g. Tennøy et al.,2015). In order for information to be intelligible it must be presented in the right format. However, none of these studies refer to requirements for legibility and comprehension, such as Braille, high-contrast text, websites accessible through screen readers, clear wording, or maps. In a review of guidelines and practices for the design and planning of measures that simplify the journey for people with disabilities, Sze and Christensen (2017) summarise that it is important to provide route information, contrasting colour, spoken information, clear and large signage as well as timetables with a large font.

Easy access to information requires a single information point that provides all the relevant details for an entire journey chain, irrespective of who the service provider is, the destination of the journey, who is subsidising the travel costs, etc. A central information point should also include routes and timetables, how accessible the means of transport is, qualification criteria for tickets and assistance, and whether assistance is available. This will give travellers the opportunity to plan and predict all parts of the journey. Travellers with disabilities can often make use of assistance, financial support, and other transport support schemes, but they must meet certain criteria. Different parts of the journey may have different criteria, depending on who the service provider is or in which municipality or county the journey is undertaken (Bjerkan et al., 2013). Forming a complete picture of all the different criteria and how they fit together thus poses a considerable challenge for passengers.

There are several reasons why information should be available at a central information point. Firstly, passengers need to be certain that the whole journey can be undertaken before they reserve or buy tickets for any part of the trip. Secondly, a single information point can reduce the time and energy needed to search for information. If a passenger with disabilities needs to consult several sources of information in order to get the full picture of the available travel alternatives and associated information about accessibility, eligibility and travel conditions, they will need more time to plan their journeys than other passengers (see also 'Minimised administration' under functional requirements). Thirdly, a single information point will give passengers the correct information about all relevant travel alternatives. Lastly, information points about facilitated transport services will ensure that information can also be presented in a tailored way, in a particular sequence and customised for each step in the journey chain (Carmien et al., 2005).

2 Flexibility

Flexibility is vital for each individual to carry out the activities they want, and as a functional requirement it refers to both flexibility **within** a transport solution and flexibility to choose **between** transport solutions. Given that people with disabilities often have difficulties using various modes of transport (Bjerkan et al., 2013), the preferred transport solution should meet the needs of individual passengers. The preferred transport solution is often the one that makes it possible to have a job, get an education or have a social life, and is thus vital for social inclusion.

Flexibility **within a transport solution** refers to flexibility in when and how someone can travel with a specific solution. Studies of transport support schemes report clear limitations on when, for what purpose and where journeys can be undertaken (Leiren et al., 2014, Lubin and Feeley, 2016, Nordbakke and Hansson, 2009, Solvoll and Anvik, 2012, Voorhees and Bloustein, 2005). Similar limitations are also found in public transport (Bezyak et al., 2017,Én studie viser at for få

kjøretøy og utilstrekkelig kapasitet kan gjøre at en støtteordning for transport i realiteten ikke er tilgjengelig for brukergruppen (Babic og Dowling 2015). Fleksibiliteten utfordres også når støtteordningen ikke tillater den reisende å endre hentesteder eller hentetider (Solvoll og Anvik 2012), noe som gjør at de reisende må bestille returreisen og reservere hentetidspunkt før de har foretatt den utgående reisen (Wasfi m.fl. 2017). Deka et al., 2016, Delbosc and Currie, 2011, Lubin and Feeley, 2016, Nordbakke and Skollerud, 2016). Although public transport routes and timetables represent the same limitations for all passengers, time and energy spent on planning, organising and undertaking journeys can lead to inflexible systems impacting passengers with disabilities in particular.

One study shows that too few vehicles and insufficient capacity can lead to a transport support scheme not being available for the user group (Babic and Dowling, 2015). Flexibility is also challenged when the support scheme does not permit passengers to change pick-up places or times (Solvoll and Anvik, 2012), which means they must book the return journey and reserve a pick-up time before they have undertaken the outward journey (Wasfi et al., 2017).

Flexibility to choose between transport solutions assumes that travellers have the option of using more than one solution. Having to rely on a single transport solution can leave travellers feeling vulnerable as this solution may not always be available. Flexibility therefore requires several transport solutions to be available for the same journey. The literature discusses these questions only fleetingly, although some studies (Bjerkan et al., 2013, Grut and Kvam, 2001, Lubin and Feeley, 2016, Nordbakke and Hansson, 2009) describe the strong position of the car and the challenges of finding transport alternatives that are equally flexible and user-friendly. Penfold et al. (2008) refer to public transport as being a less desirable option, especially at peak times, and to how the limited availability of public transport can have a significant impact on people travelling to work.

None of the studies that are included here have compared and contrasted different transport solutions. The literature nevertheless indicates that people with disabilities have fewer equal alternatives to choose from when considering the effort required to use different transport solutions. This implies that they do not have the freedom to choose the transport solutions that are most appropriate in each situation on a given day.

3 Safety and security

Fifteen of the studies under review discuss the importance of feeling safe and secure when travelling. Some point to the physical aspects of safety, where there are barriers linked to fear of falling or being injured (Logan et al., 2004, Rosenkvist et al., 2009), vehicle safety in traffic (Logan et al., 2004, Voorhees and Bloustein, 2005) and personal safety linked to, for example, being secured in the car, the condition of the vehicle and the driving behaviour of the driver (Leiren et al., 2014).

Most of the literature, however, looks at safety from a psychological perspective and links fear to transport as a social arena. Safety and security are about the individual's *experiences* while travelling. When using transport support schemes, travellers may be dependent on a regular driver who knows what they need and can adapt the journey to their needs.[1] Since the drivers are acquainted with their passengers, they are critical to ensuring that the travellers feel safe and

1 See also Øksenholt, K. V. and J. Aarhaug (2018): *Public transport and people with impairments – exploring non-use of public transport through the case of Oslo, Norway*, Disability & Society, Vol. 33 (8), p.p. 1280-1302

secure. This is also reflected in studies of public transport. Risser et al. (2012), for example, claim that communication and interaction with the (bus) driver is vital, and Aarhaug et al. (2011) present the lack of service-minded drivers as a possible problem. Bezyak et al. (2017) further underline the importance of knowledge and attitudes among drivers.

The behaviour of other passengers or groups of passengers also impacts on how safe and secure a passenger feels. Daniels et al. (2005) discuss barriers created by worrying about interaction with others as 'interpersonal constraints'. Lubin and Feeley (2016) point out that anxiety in travellers with autism is often caused by passengers with loud and brash behaviour. Similar findings have been reported by Falkmer et al. (2015), who say that passengers with an autism diagnosis experience unease when travelling on overcrowded buses and are forced to have contact with other passengers. In other studies, the reluctance to travel is linked to a lack of trust in other passengers, or a lack of confidence in the driver providing assistance if needed (Rosenkvist et al., 2009).

In addition to worrying about being disturbed by others, passengers can also be concerned that they themselves will be perceived as troublesome. This fear of embarrassing themselves or causing trouble (Logan et al., 2004) is linked to often having to manage a number of tasks in a time-efficient manner when travelling (Carlsson, 2002, Rosenkvist et al., 2009), such as paying, finding a seat, pressing the stop button, alighting, etc.

4 Physically accessible design

The UN Convention on the Rights of Persons with Disabilities (UN 2017) defines universal design as '(...)the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design. Universal design shall not exclude assistive devices for particular groups of persons with disabilities where this is needed'.

The majority of the articles under review that discuss the physical design of transport solutions deal with public transport or transport support schemes. For people with disabilities, the design of the vehicle (Bjerkan et al.,2013, Daniels et al., 2005, Lodden, 2001, LTUC, 2001) and the design of the waiting area (Babic and Dowling, 2015, LTUC, 2001, Penfold et al., 2008) are also important. One particular challenge is linked to boarding and alighting (Bjerkan, 2009, Nordbakke and Skollerud, 2016). In addition to impractical designs of stops and terminals, many passengers with disabilities experience difficulties with getting to and from these (Bezyak et al., 2017, Deka et al., 2016, Nordbakke, 2011, Voorhees and Bloustein, 2005). In some countries, this can also be caused by slippery streets and pavements and insufficient clearing of snow and ice (Aarhaug et al., 2011, Carlsson, 2002, Nordbakke and Skollerud, 2016). Long distances to stops and stations can reduce the willingness to travel by public transport, irrespective of functional ability, and solutions for park-and-ride may therefore be one way of facilitating access to public transport (Lodden, 2001). Given the prominent position of the car in the everyday transport of people with disabilities, accessible parking reserved for this group might be decisive for whether they undertake a journey or not (Babic and Dowling, 2015, Bjerkan et al., 2013, Grut and Kvam, 2001).

Many studies emphasise the importance of conditions and environments on board the transport mode. A Norwegian survey showed that 62% of public transport passengers with disabilities experience problems related to space, toilet facilities

and air quality (Bjerkan, 2009). Difficulties linked to moving around on board (Daniels et al., 2005), the placement of seats for disabled passengers (Risser et al., 2012), sitting down (Penfold et al., 2008), cleanliness (Voorhees and Bloustein, 2005) and ticket validation (Risser et al., 2012) are also relevant. The literature further mentions the importance of universal design in all modes of transport that are part of the entire journey chain (Bjerkan et al., 2013, Lodden, 2001).

5 Reliability

Transport solutions must be reliable in terms of punctuality and travel times, universal design, and robustness over time. Reliability entails that users can trust that the service will arrive at the right time and that they can expect to arrive at the destination on time. This depends on the transport provider having a robust system in place to manage unforeseen events, such as driver absence due to illness, vehicle breakdowns, changes to the timetable, etc. Passengers must be informed of delays or cancellations. Reliability is thus closely linked to the delivery of the transport solution.

Reliability is important for all passengers, but unreliability can be expected to have a particularly negative effect on travellers with disabilities. In the evaluation of a transport support scheme, punctuality was described as the most valued aspect of the service (Denson, 2000). According to Solvoll and Anvik (2012), delays are a major source of stress for people with disabilities, and the significance of delays and irregular services is discussed in several studies (Aarhaug et al., 2011, Beart et al., 2001, Buffart et al., 2009, Grut and Kvam, 2001).

Delays and irregular service also pose a particular challenge in transport support schemes, which are unpredictable because they do not follow set routes or timetables (Beart et al. 2001, Bezyak et al., 2017, Grut and Kvam, 2001, Leiren et al., 2014, Nordbakke and Hansson, 2009, Voorhees and Bloustein, 2005,) and because the users are rarely informed about delays and changes to arrival times (Voorhees and Bloustein, 2005). Although it is not explicitly discussed in the studies under review, this may be a functional requirement that is easier to meet with the increasing use of smartphones and real-time information.

To some extent, reliability overlaps with the functional requirement for short, predictable travel times (8), since delays normally increase both the waiting and travel time. However, predictable travel times may be more critical than the travel time itself. Unpredictable travel times make it hard to plan journeys in everyday life, and for people with disabilities, being able to plan well ahead of time may well be a prerequisite for mastering travel and other challenging everyday tasks (Bjerkan et al., 2013).

Reliability is also linked to travellers' expectations of design and assistance from others (Buffart et al., 2009, Delbosc and Currie, 2011, Grut and Kvam, 2001). It also concerns expectations and uncertainty linked to whether transport support schemes will be continued, for example because of annual budgets (Solvoll and Anvik, 2012), and whether the scheme will actually meet the requirements of the user in the future. Delays in the administration of support scheme applications can for example imply that applicants' requirements change during the waiting period (Deloitte, 2012).

6 Economic predictability

This functional requirement primarily revolves around the ability to pay. A number of studies emphasise the importance of reasonably priced tickets and fares (Aarhaug et al., 2011, Buffart et al., 2009, Lubin and Deka, 2012, Nordbakke, 2011). To many people with disabilities, the car is the only realistic mode of transport (Bjerkan et al., 2013), and if they cannot afford to own an adapted car this will impact their participation in economic, political, cultural, and social activities. In some cases, transport support schemes enable the use of certain transport solutions. However such schemes are often subjected to continual reviews both in terms of budgeting and allocation criteria. With the public purse under pressure, it is difficult for travellers to assess whether and to what extent they can rely on these schemes in the future.

This functional requirement thus presupposes an expectation of being able to pay. Users need to have a clear expectation of what costs and expenditure will be in the foreseeable future; it can be a considerable burden not knowing whether, for example, transport support schemes will continue to exist or whether you can expect to qualify for these. This is particularly true for transport support schemes that are funded through annual budgets (Solvoll and Anvik, 2012) on a 'first come first served' basis. This kind of unpredictability can undermine social inclusion, particularly in relation to education and employment. Uncertainly about transport can increase the risk of turning down job offers and study places (Bjerkan et al., 2013). Consequently, opportunities for economic freedom and social inclusion will be further restricted because of a marginalised position in the labour market.

7 Minimised administration

Undertaking a journey often involves extensive administration and planning by the traveller (Bezyak et al., 2017, Bjerkan et al., 2013, Deloitte, 2012, Grut and Kvam, 2001, Nordbakke and Hansson, 2009), especially when it comes to the use of public transport and transport support schemes. Support scheme applications can entail lengthy processing times and the administrative procedure is often complicated. Submitting an application often requires extensive user competence, and applicants must have knowledge about legislation, guidelines, rights, appeal procedures, etc. One study shows that people with disabilities perceive the system as overwhelming because many need to familiarise with and manage several different transport support schemes, different allocation criteria, constraints and booking routines, and because they have to learn when and how they can start using the service (Voorhees and Bloustein, 2005). The users often have little access to advice about using the service, and in some cases potential users are not even aware of the existence of support schemes.

This functional requirement 'Administration' also includes planning each individual trip. A Norwegian study (Bjerkan et al., 2013) shows that pre-planning travel is an important part of organising everyday life, and that the undertaking of a journey is based on mental plans and strategies for dealing with unexpected situations, such as getting off at the wrong stop, failing to find a parking space, or late or vehicle breakdowns. The time and energy spent on transport planning and administration can leave less time for other activities and make it more difficult to work, pursue career ambitions and participate in social events (Bjerkan et al., 2013, Voorhees and Bloustein, 2005).

To some extent, travel administration and planning is linked to the first functional requirement, 'Accessible, centralised information', which can make the planning less stressful. Information is vital to have sufficient knowledge about alternative routes and modes of transport, and the pros and cons of these alternatives. With information in place, travellers will be able to reflect on and assess the various alternatives and implications, and then organise and carry out the travel plans. In many cases, travellers will also work out a plan B in case the preferred plan cannot be executed.

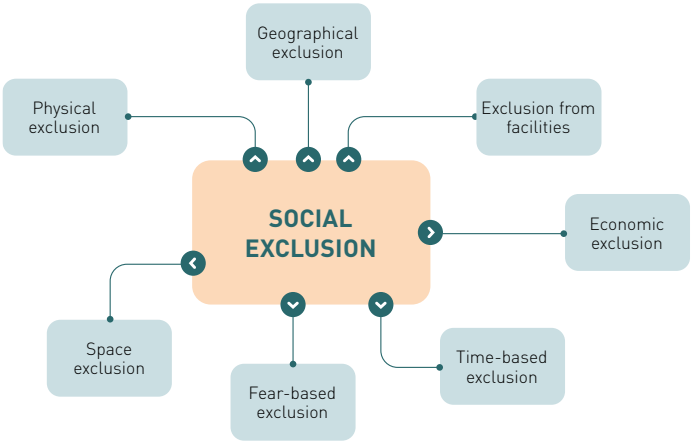
8 Short, predictable travel times

The time a journey takes is especially important when it comes to choosing a transport solution (Hensher, 2001, McKnight, 1982, Wardman, 2004), and an important functional requirement is that the travel time is not disproportionately long. Lengthy journeys can be a considerable challenge for people with disabilities (Bezyak et al., 2017, Grut and Kvam, 2001, Verbich and El-Geneidy, 2016, Voorhees and Bloustein, 2005), because the total time spent on a journey does not only include the time on board, but also waiting times and the time spent on planning and organising the whole journey chain.

To people with disabilities, disproportionately long travel times may occur, for example, during complex journeys involving transport support schemes, but where the scheme does not cover all the travel purposes within the journey chain (Grut and Kvam, 2001). One example of this is if, during the course of a journey chain, a traveller needs to use the support scheme for travelling to work, for collecting children from school or day care and grocery shopping. Unpredictable and long travel times can force employees with disabilities to start their work journey very early in the morning in order to get to work on time, something which results in extremely long working days (ibid.). As such, this functional requirement is related to the functional requirement 'Flexibility', since long travelling times reduce the opportunity to manage other tasks and responsibilities.

3.1 Discussion

Functional requirements and social inclusion



This study presents trends in empirical research on transport barriers for and people with disabilities, and defines eight functional requirements (FR) that transport solutions must meet if they are to contribute to social inclusion. This is further exemplified below with reference to mobility-related social exclusion as described by Church et al., (2000). Firstly, Church et al. claim that physical barriers in transport are linked to the built environment around the transport system. **Physical exclusion** can be reduced or completely removed through universal design of stops and stations and access to these, the environment on board and the vehicle itself.

Geographical exclusion occurs when a person is prevented from taking part in activities outside their immediate local area (Church et al., 2000). Geographical exclusion may be due to limited access to transport and the limited reach of existing transport solutions. This may be because of, for example, restrictions on where transport support schemes can be used: transport support schemes can often not be used across municipal or county borders. In the same way, restrictions on the purposes for which the support scheme is valid (work trips, health services, travelling length, time of travel), can contribute to the user being excluded from geographical areas that have facilities they need. The functional requirement that deals with flexibility can therefore be vital for ensuring geographical inclusion.

Preventing geographical exclusion is largely a question of land use planning and the establishment of a transport service. If there is already a considerable geographical distance between the individual and the transport service, the prevention of geographical exclusion is dependent on the transport service being attractive, with features such as short, predictable travel times (FR 8), universal design (FR 6), as well as reliable (FR5) and safe (FK2) transport solutions.

The same functional requirements can help to counteract **economic exclusion.** Church et al. (2000) link this to inadequate transport solutions limiting participation in employment, and claim that the flaws in the transport solutions are due to a lack of universal design and high costs both in terms of money and time. By further securing time-efficient transport (FR 8) and manageable costs (FR 6), economic exclusion from transport can be reduced.

The literature review shows that time is an important aspect. **Time-based exclusion** (Church et al., 2000) is not only about how much time is spent travelling, but also about the time available for travel. For people with disabilities, this is a product of the time spent planning and organising travel and the rest of their daily life, as well as long and unpredictable waiting times. In other words, the time that is needed to plan, organise and worry about transport reduces the time available for other activities. Transport solutions that meet functional requirements linked to travelling times (FR 8), reliability (FR 5), flexibility (FR 3), administration (FR 7) and design (FR 4), can thus reduce time-based exclusion.

Finally, Church et al. (2000) point out that the traveller's perception of insecurity and anxiety affects how they use transport systems and public spaces. Perceived insecurity can be caused by unease linked to the driver or other passengers (Falkmer et al., 2015, Leiren et al., 2014), interaction with other people or technology (Risser et al., 2012), or worries about personal safety or injury (Penfold et al., 2008, Rosenkvist et al., 2009). Others claim that fear in itself is not a major barrier to travel, but that uncertainty and an expectation of encountering difficulties still constitute a challenge (Asplund et al., 2012).

'The inclusion of psychological barriers such as fear, worry, insecurity and expectation in the functional requirements constitutes a challenge. Such barriers are highly subjective, dependent on the context and the individual passenger, and may occur in different stages of the travel chain and in different situations.'

The inclusion of psychological barriers such as fear, worry, insecurity and expectation in the functional requirements constitutes a challenge. Such barriers are highly subjective, dependent on the context and the individual passenger, and may occur in different stages of the travel chain and in different situations. It is thus difficult to define one functional requirement that on its own addresses the diversity of worries and anxieties linked to travel. These aspects are therefore discussed in relation to concrete challenges that come under other functional requirements (e.g. information about the design of the different modes of transport). Providing accessible information about the journey in one place and any accessible assistance during the journey (FR1), can for example contribute to reducing stress and worry both before and during the journey. Drivers with good communication skills and the ability to foresee and meet passengers' requirements can also improve trust, predictability and security (FR3), and thus help to reduce stress and embarrassment. Embarrassment can also be remedied through standardised physical design (FR4), and by the degree to which solutions for payment, stop signals and so on are appropriately designed. Finally, predictable and robust transport solutions (FR 5) can help reduce anxiety. Any changes to routes, timetables or arrival times should be clearly and immediately communicated to passengers as deviating from plan A can create stress and anxiety. Alternative travel suggestions or solutions that help travellers work out a plan B or plan C should also be available.

3.2 Implications for transport providers and planners

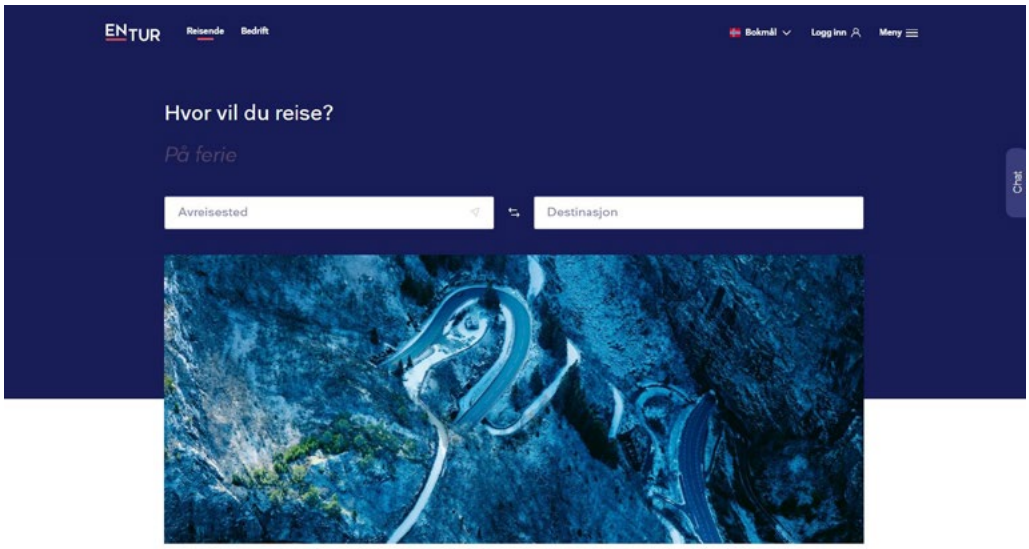
Part 3 discussed functional requirements that transport solutions should address to facilitate social inclusion among people with disabilities. In order to meet the functional requirements, the provider of the transport solution must be aware of these requirements and establish strategies to address them. This section primarily discusses these issues within a Norwegian context.

Transport solutions are almost exclusively delivered by two groups of service providers: i) providers of public transport and mobility services (i.e. public transport companies and others offering transport by bus, train, boat, ferry, tram, taxi, city bike, e-scooter etc.), and ii) public agencies that administer the transport support schemes (the Norwegian Labour and Welfare Administration (NAV), county authorities, health trusts). The following sections discuss how the two types of service providers can meet the functional requirements presented above.

FR 1 Accessible, centralised information

Accessible, centralised information about *public transport and mobility services* is mostly to do with the traveller having information about all possible transport solutions they can use, collected in one place.

This requires communicating and sharing information across different service providers, and can for example be provided through one common travel planner (e.g. EnTur in Norway or UbiGo in Sweden) that all service providers are linked to. By connecting different mobility services, passengers will be able to purchase mobility from one place to another without having to worry about who delivers the different services.



Mobility-as-a-Service is a service that, through a common digital channel, makes it possible for consumers to plan, book and pay for several kinds of mobility services. The concept represents a shift away from personally-owned modes of transport and towards mobility offered as a service. Source: https://maas-alliance.eu/

This is often called 'combined mobility' or 'Mobility-As-A-Service' (MAAS). Travellers will thus only have to relate to one provider, one place for payment and one ticket. It is, however, important that the communication channels themselves are accessible and universally designed, irrespective of whether they are in a printed format, a mobile phone app, a website, a screen at a stop or station, a customer service centre, or other channel.

In order for information to contribute to social inclusion, it must also inform about accessibility issues and universal design status at all stages of the journey. This includes information about available assistance, the design of vehicles (number of seats, ramp, loudspeaker announcements, real-time schedule) and platforms/stops/terminals (e.g. guidance path surface, negotiability for wheelchairs, announcements, two-way communication, lighting, availability of seats). Travellers should also have information about the maintenance (snow clearing, gritting, shelter/seats) of stops and stations as well as information about the access to the stops and stations (Tennøy et al., 2015).

'In order for information to contribute to social inclusion, it must also inform about accessibility issues and universal design status at all stages of the journey.'

A prominent challenge when it comes to making **information about transport support schemes easily accessible,** is the myriad of different schemes, administered by different actors (NAV, county authorities, health trusts), and with different areas of use and allocation criteria. For that reason, there have previously (Bjerkan et al., 2015) been arguments in favour of national coordination of public transport support schemes, so that individual users have fewer schemes to deal with. This would also reduce the need for information (see also FR7, Minimised administration).

Passengers' need for information can be better met by communication of real-time information about transport that is pre-booked and/or underway.

FR2 Flexibility

Private cars or transport support schemes are often the only travel options for many people with disabilities. Ordinary *public transport or mobility services* are therefore often regarded as out of the question. One way of creating greater freedom of choice and greater flexibility in the choice of transport solutions, thereby facilitating social inclusion, might be to include taxi services in ordinary, combined mobility services (MAAS). Even though this has not been explicitly discussed in the existing literature, it can be presumed that many would find travelling by public transport more likely if the journeys to and from the stops and stations could be carried out by taxi. This is particularly relevant in areas with limited public transport services. Including taxis as a transport service in MAAS can thus make ordinary public transport services more relevant for travellers with disabilities. Another possibility is further extending park-and-ride schemes linked to major public transport hubs where a number of parking spaces are reserved for people with disabilities. It can also be worth discussing whether the opportunity to use a travelling companion to and from stops and stations, or assistance at the stops, might make it easier to choose public transport.

'In terms of transport support schemes, flexibility can be promoted by travellers themselves deciding which purposes the travel support scheme is used for.'

In terms of *transport support schemes*, flexibility can be promoted by travellers themselves deciding which purposes the travel support scheme is used for. In a hypothetical user-oriented transport support scheme, the users themselves can decide how to use their mobility support. Mobility needs can vary from one day to another, according to a person's schedule or health, or according to what travel is undertaken and between what locations. A common mobility support system could, for example, be based on the coordination of existing transport support schemes with uniform national guidelines and budgets, but with local assessments of mobility requirements. This could contribute to flexibility in that municipal and county restrictions on using transport support schemes would disappear (see a more detailed discussion of this in Bjerkan et al., 2015). To the extent that a single unified transport support scheme would also imply fewer separate transport routes, this could make it easier to optimise and improve transport included in the support scheme and thus reduce both travelling and waiting times.

FR3 Safety and security

Safety is a multifaceted functional requirement that ranges from practical factors, such as the characteristics of vehicles, to psychological barriers. It can be particularly challenging for service providers to promote psychological or subjective safety, but in this context available information and positive experiences form an important basis. The subjective feeling of safety also depends on all the other functional requirements being met.

A number of factors can help to make passengers feel safe, regardless of the transport solution in question, including calm and comfortable driving, requirements for the standard and maintenance of vehicles, and in some cases, sufficiently securing passenger on-board. Since safety is linked to predictability

and coping, the standardised design of stops and stations can also be important because it reduces traveller anxiety. Examples of such standardisation include ticket machines, lighting, placement, and design of information at stops and stations, announcements, possibility of two-way communication, etc. Standardised design for stops enables travellers to use all stops.

Transport providers can promote a feeling of safety when using *public transport and mobility services* by ensuring that their drivers are appropriately trained and updated, with a focus on how to provide good service to all user groups and general knowledge of what all user groups need.

This is also particularly important for providers of *transport support schemes* that offer their own transport solutions for travellers. The drivers should have training and experience with different passenger groups and be personally suited to this type of work.

The driver is often part of the traveller's safety net, particularly the last 50 metres to their own front door, and it is vital for traveller safety that drivers are conscious of this role. Regular, patient and service-minded drivers should therefore be a priority for the service provider, and service providers should train their personnel in giving the right service to passengers with disabilities. Service providers should also establish routines for dealing with unforeseen events inside or outside vehicles that are, or could be perceived to be, unsafe for the passengers.

FR4 Physically accessible design

This functional requirement is about the physical design of vehicles, stops and access. It also encompasses practical conditions on board: space, number and placement of reserved seats. Universal design of transport solutions has been given a lot of attention in scientific literature, with a particular focus on public transport. This literature provides detailed descriptions of how vehicles and stops should be designed in order to be accessible, and describes methods for measuring the degree of accessibility (see Øvstedal, 2009, Øvstedal and Meland, 2011 for an overview).

FR5 Reliability

Ensuring reliability in *public transport and mobility services* is about reducing delays and providing information about delays that occur, as well as the new expected schedule and arrival time. In order to manage delays effectively, the service provider should have a system for handling unforeseen events. This functional requirement is also about the traveller having access to assistance when needed, which creates a feeling of safety and security. One possible innovation for providers of public transport and mobility services could be to offer assistance at transport hubs, such as that provided by Avinor (the Norwegian state's airport operator) at airports, in order to ensure reliability in the whole journey chain.

Reliability in *transport support schemes* is also includes providing information about delays and expected changes in schedules and arrival times, and a system for handling factors that create delays. Real-time information about arrival times is also important. This type of information allows travellers to decide whether they can wait for the transport to arrive or whether alternative transport is needed..

As far as transport support schemes are concerned, reliability is particularly linked to the predictability of access to the support schemes: that travellers can rely on having access to the scheme over time. Such predictability and knowledge depend on a (continual) dialogue between users and administrators of the support scheme, longer allocation periods and more details and transparency in the dialogue around applications.

FR6 Economic predictability

This functional requirement refers to each traveller being able to afford to use the services they need in order to meet their mobility needs, and that they are confident they will be able to afford it in the foreseeable future. For *public transport and mobility services,* this requires recognisable and coordinated fares, discounts, customer categories across service providers and coordinated criteria for placement in these categories. For official *transport support schemes,* economic predictability largely related to coordinating of content and administration of the services (also described under FR2, Flexibility). Allocation periods and budgeting over several years can be especially important for economic predictability.

FR7 Minimised administration

Minimised administration implies that travellers does not need to spend an unreasonable amount of time and energy on rules and procedures in the application for and use of transport solutions. For *public transport and mobility services,* administration can be simplified through improved information (FR1) and more coordination of fares, discounts and customer categories (FR6).

'Transport support schemes should be coordinated to reduce and simplify administration for both users and public authorities. Forms, criteria for differentiation, approval and complaints should be simplified.'

As previously described, *transport support schemes* should be coordinated reduce and simplify administration for both users and public authorities. Forms, criteria for differentiation, approval and complaints should be simplified. Bjerkan et al. (2015) propose several administrative simplifications of transport support schemes: a uniform medical certificate form; uniform approval and differentiation criteria; a common approval body; a uniform complaints procedure and rules and a common appeals body; standardisation of travel documents and decision-making on user contribution.

FR8 Short, predictable travel times

The last functional requirement is about efficient travel chains. This requires appropriate design of the *public transport system* and opportunities for combining modes of transport without increasing the time spent waiting for or transferring. As previously mentioned, some groups may benefit from replacing particularly time-consuming travel elements with taxis. Improved coordination of *transport support schemes* can also give the user more flexibility and shorter waiting times due to the optimisation of transport services as a larger number of users in a given area uses the same support scheme.

4. Conclusion and discussion

This study presents trends in empirical research on transport and disability and proposes eight functional requirements that should be met by transport solutions to facilitate social inclusion. The study is based on research literature from countries with similar socio-cultural systems and relatively comparable transport and mobility systems. It cannot therefore be automatically assumed that the functional requirements presented here are relevant or applicable on a global level.

On a worldwide basis, it is likely that regional political differences impact the extent and implementation of strategies for the inclusion of people with disabilities. In the transport sector, such policies can be reflected in visions and strategies for universal design, or financial and practical support for travel assistance and personal user support. Differing policies and economic, social and cultural contexts can also have a bearing on the barriers that are emphasised in the literature, and thus the relative weight and relevance of the functional requirements. We therefore need comparative studies that take into account different contexts and realities to contribute valuable width to this research field.

We can nevertheless assume that the functional requirements discussed here are relevant for all societies where daily activities take place in different locations and according to a schedule. The transferability of the functional requirements is not a question of the content of the requirements, but rather of how extensively and in what manner these requirements are complied with and requested. This can be expected to vary considerably between regions, countries, and communities.

A wheelchair user in a sparsely populated area of Finland may, for example, require a permanent transport support scheme (reliability) that allows the user to travel from and to wherever they wish (flexibility), without having to worry about allocation criteria and restrictions (economy and predictability). The vehicle must also ensure that the

traveller is safe (safety), and must be designed in such a way that they can get on board without difficulty and can communicate with the driver (universal design).

In the same way, a wheelchair user in a large city in India may require public transport with reliable connection times (reliability) that allows them to use the whole transport network (flexibility) on one ticket, irrespective of the number of providers (economic predictability, minimised administration). A traveller's independent mobility depends on low, step-free boarding, accessible stop signals and sufficient space on board every type of transport (safety, universal design).

Hence, the same functional requirements are present in both scenarios. However, the implementation and operationalisation vary between transport systems and social systems. It is important to emphasise that social inclusion of people with disabilities is not guaranteed simply by meeting these functional requirements. Social inclusion depends on broad and complex measures, and there needs to be correspondence between initiatives aimed at education, employment, social participation, welfare systems and transport. Barriers to social inclusion in these areas vary from one society to the next, both in severity and character. Social exclusion is a multi-dimensional phenomenon with parallel processes that reinforce each other (Schwanen et al., 2015). As such, the functional requirements presented here are necessary, but not sufficient to prevent social exclusion..

5. Summary

The purpose of this study was to review existing research on transport barriers that may impact on social inclusion of people with disabilities. The study proposes a set of requirements that can be used to assess whether a given transport solution is appropriate for people with disabilities. Inclusive transport constitutes a gateway to political, economic, and social arenas that are fundamental for social inclusion.

Although the functional requirements presented here do not constitute a practical evaluation tool, they can be regarded as a systematic approach to subjective assessments of transport solutions. Defining functional requirements is an important step towards establishing criteria for assessing current transport solutions and for the à priori evaluation of planned solutions. The requirements were defined without reference to particular destinations or transport modes, and can be used irrespective of who the traveller is. The functional requirements do not introduce new knowledge, but they are derived by summarising and transforming existing knowledge about known barriers and conditions into specific criteria that can be used to improve both current and future transport solutions.

References

Aarhaug, J., B. Elvebakk, N. Fearnley and M. Lerudsmoen (2011): Enhanced accessibility to public transport: a before study, Oslo:Institute of Transport Economics, TØI report 1174/2014

Asplund, K., S. Wallin and F. Jonsson (2012): Use of public transport by stroke survivors with persistent disa-bility, Scandinavian Journal of Disability Research, Vol. 14 (4), s. 289-299

Babic, M. M. and M. Dowling (2015): Social support, the presence of barriers and ideas for the future from

students with disabilities in the higher education system in Croatia, Disability & Society, Vol. 30 (4), s. 614-629

Beart, S., D. Hawkins, B. S. Kroese, P. Smithson and I. Tolosa (2001): Barriers to accessing leisure opportunities for people with learning disabilities, British Journal of Learning Disabilities, Vol. 29 (4), s. 133-138

Bezyak, J. L., S. A. Sabella and R. H. Gattis (2017): Public Transportation: An Investigation of Barriers for People With Disabilities, Journal of Disability Policy Studies, Vol. 28 (1), s. 52-60

Bhalla, A. and F. Lapeyre (1997): . Social Exclusion: Towards an Analytical and Operational Framework, Development and Change, Vol. 28 (3), s. 413-433

Bjerkan, K. Y. (2009): Funksjonshemmende kollektivtransport? Transportbruk og transportvansker blant personer med nedsatt funksjonsevne, Oslo Norsk institutt for forskning om oppvekst, velferd og aldring, NOVA Notat 2/09 (Norwegian only)

Bjerkan, K. Y., M. E. Nordtømme and A.-M. Kummeneje (2013): Transport to employment, Scandinavian Journal of Disability Research, Vol. 15 (4), s. 342-360

Bjerkan, K. Y., L. Øvstedal, M. E. Nordtømme, A.-M. Kummeneje og G. Solvoll (2015): Transportordninger og arbeidsdeltakelse. Transport og arbeid

blant personer med nedsatt funksjonsevne, Trondheim: SINTEF Teknologi og samfunn, SINTEF Rapport A27047

Bodde, A. E. and D.-C. Seo (2009): A review of social and environmental barriers to physical activity for adults with intellectual disabilities, Disability and Health Journal, Vol. 2 (2), s. 57-66

Buffart, L. M., T. Westendorp, R. J. v. d. Berg-Emons, H. J. Stam and M. E. Roebroeck (2009): Perceived barriers to and facilitators of physical activity in young adults with childhood-onset physical disabilities, Journal of Rehabilitation Medicine, Vol. 41 (11), s. 881-885

Burchardt, T., J. Le Grand and D. Piachaud (1999): Social Exclusion in Britain 1991—1995, Social Policy & Administration, Vol. 33 (3), s. 227-244

Carlsson, G. (2002): Catching the Bus in Old Age - Methodological Aspects of Accessibility Assessments in Public Transport, Lund: Lund University, Division of Occupational Therapy, Dissertation

Carmien, S., M. Dawe, G. Fischer, A. Gorman, A. Kintsch and J. James F. Sullivan (2005): Socio-technical environments supporting people with cognitive disa-bilities using public transportation, ACM Trans. Comput.-Hum. Interact., Vol. 12 (2), s. 233-262

Charmaz, K. (2006): Constructing Grounded Theory. A Practical Guide Through Qualitative Analysis, London:Sage Publications

Church, A., M. Frost and K. Sullivan (2000): Transport and social exclusion in London, Transport Policy, Vol. 7 s. 195-205

Daniels, M. J., E. B. Drogin Rodgers and B. P. Wiggins (2005): «Travel Tales»: an interpretive analysis of constraints and negotiations to pleasure travel as expe-rienced by persons with physical disabilities, Tourism Management, Vol. 26 (6), s. 919-930

Deka, D., C. Feeley and A. Lubin (2016): Travel Patterns, Needs, and Barriers of Adults with Autism Spectrum Disorder:Report from a Survey, Transportation Research Record, Vol. 2542 (1), s. 9-16

Delbosc, A. and G. Currie (2011): Transport problems that matter – social and psychological links to transport disadvantage, Journal of Transport Geography, Vol. 19 (1), s. 170-178

Denson, C. R. (2000): Public sector transportation for people with disabilities: a satisfaction survey, Journal of Rehabilitation, Vol. 66 (3), s. 29-37

Falkmer, M., T. Barnett, C. Horlin, O. Falkmer, Siljehav, S. Fristedt, H. C. Lee, D. Y. Chee, A. Wretstrand and T. Falkmer (2015): Viewpoints of adults with and without Autism Spectrum Disorders on public transport, Transportation Research Part A: Policy and Practice, Vol. 80 s. 163-183

Farrington, J. (2007): The new narrative of accessibility: its potential contribution to discourses in (transport) geography, Journal of Transport Geography, Vol. 15 (5), s. 319-3330

FN (2017): Convention on the Rights of Persons with Disabilities, New York: United Nations CRPD/CSP/2017/4 https://www.un.org/disabilities/documents/COP/crpd_csp_2017_4.pdf

French, D.and J. Hainsworth (2001): 'There aren't any buses and the swimming pool is always cold!': obstacles and opportunities in the provision of sport for disabled people, Managing Leisure, Vol. 6 (1), s. 35-49

Goodman, L. A. (1961): Snowball Sampling, The Annals of Mathematical Statistics, Vol. 32 (1), s. 148-170

Grut, L. og M. H. Kvam (2001): De sier du skal ha det tilnærma likt et annet liv, men det er jo slettes ikke det. En kvalitativ intervjuundersøkelse om funksjonshemmedes opplevelse av deltakelse og hindringer i dagliglivets aktiviteter, SINTEF, SINTEF rapport A6692 (Norwegian only)

Hensher, D. A. (2001): Measurement of the Valuation of Travel Time Savings, Journal of Transport Economics and Policy (JTEP), Vol. 35 (1), s. 71-98

Hine, J. og F. Mitchell (2001): The role of transport in social exclusion in urban Scotland, Edinburgh: Scottish Executive Central Research Unit,

Hsieh, H.-F. og S. E. Shannon (2005): Three Approaches to Qualitative Content Analysis, Qualitative Health Research, Vol. 15 (9), s. 1277-1288

Imrie, R. (2000): Disability and discousces of mobility and movement, Environment and Planning, Vol. 32 s. 1641-1656

Kaufmann, V. (2002): Re-thinking Mobility, Farnham: Ashgate

Kellerman, A. (2006): Personal Mobilities, London: Routledge

Kenyon, S., G. Lyons og J. Rafferty (2002): Transport and social exclusion: investigating the possibility of promoting inclusion through virtual mobility, Journal of Transport Geography, Vol. 10 (3), s. 207-219

Lee, P. og A. Murie (1999): Literature Review of Social Exclusion, Scottish Office Central Research Unit

Leiren, M. D., J. Aarhaug, J. R. Krogstad og Skollerud (2014): Samordning av offentlig betalt spesialtransport i Akershus og Oslo., Oslo Transportøkonomisk institutt, TØI-rapport 1297/2014 (English summary)

Levitas, R., C. P. E. Fahmy, D. Gordon, E. Lloyd and D. Patsios (2007): The Multi-Dimensional Analysis of Social Exclusion, Bristol: University of Bristol

Lodden, U. B. (2001): Enklere kollektivtilbud. Barrierer mot kollektivbruk og tiltak for et enklere tilbud, Transportøkonomisk institutt, TØI-rapport 540/2001 (English summary)

Logan, P. A., J. Dyas og J. R. F. Gladman (2004): Using an interview study of transport use by people who have had a stroke to inform rehabilitation, Clinical Rehabilitation, Vol. 18 (6), s. 703-708

LTUC (2001): Easing the trip. Meeting the needs of disabled rail users, London: The London Transport Users Committee, http://www.londontravelwatch.org.uk/documents/get_lob?id=2550&age=&field=file

Lubin, A. og D. Deka (2012): *Role of Public Transportation as Job Access Mode:Lessons from Survey of People with Disabilities in New Jersey*, Transportation Research Record, Vol. 2277 (1), s. 90-97

Lubin, A. og D. Deka (2012): Role of Public Transportation as Job Access Mode: Lessons from Survey of People with Disabilities in New Jersey, Transportation Research Record, Vol. 2277 (1), s. 90-97

Lubin, A. og C. Feeley (2016): Transportation Issues of Adults on the Autism Spectrum: Findings from Focus Group Discussions, Transportation Research Record, Vol. 2542 (1), s. 1-8

Lucas, K. (2012): Transport and social exclusion: Where are we now?, Transport Policy, Vol. 20 (0), s. 105-113

McKnight, A. (1982): The value of travel time saving in public sector evaluation, Canberra: Bureau of Transport Economics, Occasional Paper 51 https://bitre.gov.au/publications/1982/files/op_051.pdf

Nordbakke, S. (2011): Fysiske problemer med å bruke transportmidler. Omfang, kjenenteng, reisevaner og opplevelse av barrierer, Oslo Transportøkonomisk Insitutt, TØI rapport 1148/2011 (English summary)

Nordbakke, S. og L. Hansson (2009): Mobilitet og velferd blant bevegelseshemmede - bilens rolle, Oslo Transportøkonomisk institutt, TØI-rapport 1041/2009 (English summary)

Nordbakke, S. og K. Skollerud (2016): Transport, Unmet Activity Needs and Wellbeing Among People with Physical Disabilities. Institute of Transport economics, Oslo: Institute of Transport Economics, TØI Report 1465/2016

Nussbaum, M. (2011): Creating Capabilities: The Human Development Approach, Harvard University Press

Penfold, C., N. Cleghorn, C. Creegan, H. Neil og S. Webster (2008): Travel behaviour, experiences and aspirations of disabled people, London: National Centre for Social Research,

Reynolds, F. (2002): An exploratory survey of opportunities and barriers to creative leisure activity for people with learning disabilities, British Journal of Learning Disabilities, Vol. 30 (2), s. 63-67

Rimmer, J. H., B. Riley, E. Wang, A. Rauworth and J. Jurkowski (2004): Physical activity participation among persons with disabilities: Barriers and facilitators, American Journal of Preventive Medicine, Vol. 26 (5), s. 419-425

Risser, R., S. Iwarsson og A. Ståhl (2012): How do people with cognitive functional limitations post-stroke manage the use of buses in local public transport?, Transportation Research Part F, Vol. s. 111-118

Rosenbloom, G. (2007): Transportation Patterns and Problems of People with Disabilities, in Field, M. J. og A. M. Jette: «The Future of Disability in America», Washington DC: National Academies Press, s.

Rosenkvist, J., R. Risser, S. Iwarsson, K. Wendel og A. Ståhl (2009): The challenge of using public transport: descriptions by people with cognitive functional limitations, Journal of Transport and Land Use, Vol. 2 (1), s. 65-80

Schwanen, T., K. Lucas, N. Akyelken, D. C. Solsona, A. Carrasco og T. Neutens (2015): Rethinking the links between social exclusion and transport disadvan tage through the lens of social capital, Transportation Research Part A, Vol. 74 s. 123-135

Sen, A. (2000): Social exclusion: Concept, applica tion, and scrutiny, Manila: Office of Environment and Social Development, Asian Development Bank, Social Development Paper No 1 https://www.adb.org/sites/default/files/publication/29778/social-exclusion.pdf

Shields, N., A. J. Synnot oand M. Barr (2012): Perceived barriers and facilitators to physical activity for children with disability: a systematic review, British Journal of Sports Medicine, Vol. 46 (14), s. 989-997

Smith, B. J., M. Thomas og D. Batras (2015): Overcoming disparities in organized physical activity: findings from Australian community strategies, Health Promotion International, Vol. 31 (3), s. 572-581

Solvoll, G. og C. H. Anvik (2012): Arbeids- og utdanningsreiser for funksjonshemmede. Erfaringer etter 10 år., Handelshøgskolen i Bodø, Senter for innovasjon og bedriftsøkonomi, SIB AS., SIB-rapport nr. 1-2012 (Norwegian only)

Stanley, J. og K. Lucas (2008): Social exclusion: What can public transport offer?, Research in Transportation Economics, Vol. 22 (1), s. 36-40

Sze, N. N. og K. M. Christensen (2017): Access to urban transportation system for individuals with disabili-ties, IATSS Research, Vol. 41 (2), s. 66-73

Tennøy, A., K. V. Øksenholt, N. Fearnley og B. Matthews (2015): Standards for usable and safe environments for sight impaired, Proceedings of the Institution of Civil Engineers - Municipal Engineer, Vol. 168 (1), s. 24-31

Verbich, D. og A. El-Geneidy (2016): The pursuit of satisfaction: Variation in satisfaction with bus transit service among riders with encumbrances and riders with disabilities using a large-scale survey from London, UK, Transport Policy, Vol. 47 s. 64-71

Voorhees, A. M. og E. J. Bloustein (2005): Meeting the Employment Transportation Needs of People with Disabilities in New Jersey, The State University of New Jersey, Final Report for the New Jersey Department of Human Services

Wardman, M. (2004): Public transport values of time, Transport Policy, Vol. 11 (4), s. 363-377

Wasfi, R., M. Steinmetz-Wood og D. Levinson (2017): Measuring the transportation needs of people with developmental disabilities: A means to social inclusion, Disability and Health Journal, Vol. 10 (2), s. 356-360

WHO (2013): How to use the ICF: A practical manual for using the International Classification of Functioning, Disability and Health (ICF), Geneva: World Health Organization, Exposure draft for comment

Wixey, S., P. Jones, K. Lucas og M. Aldridge (2005): Measuring accessibility as experienced by different socially disadvantaged groups, London: University of Westminster, Transport Studies Group,

Øksenholt, K. V. og J. Aarhaug (2018): Public transport and people with impairments – exploring non-use of public transport through the case of Oslo, Norway, Disability & Society, Vol. 33 (8), s. 1280-1302

Øvstedal, L. (2009): Litteraturstudie om universell utforming i transport, Trondheim:SINTEF, SINTEF Rapport A10438

Øvstedal, L. og S. Meland (2011): Indikatorer for universell utforming for kollektivtrafikk på vei, Trondheim:SINTEF, SINTEF Rapport A17546

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