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Universal design in transport

Editors: Nils Fearnley and Kjersti Visnes Øksenholt

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Table of contents

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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.

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).

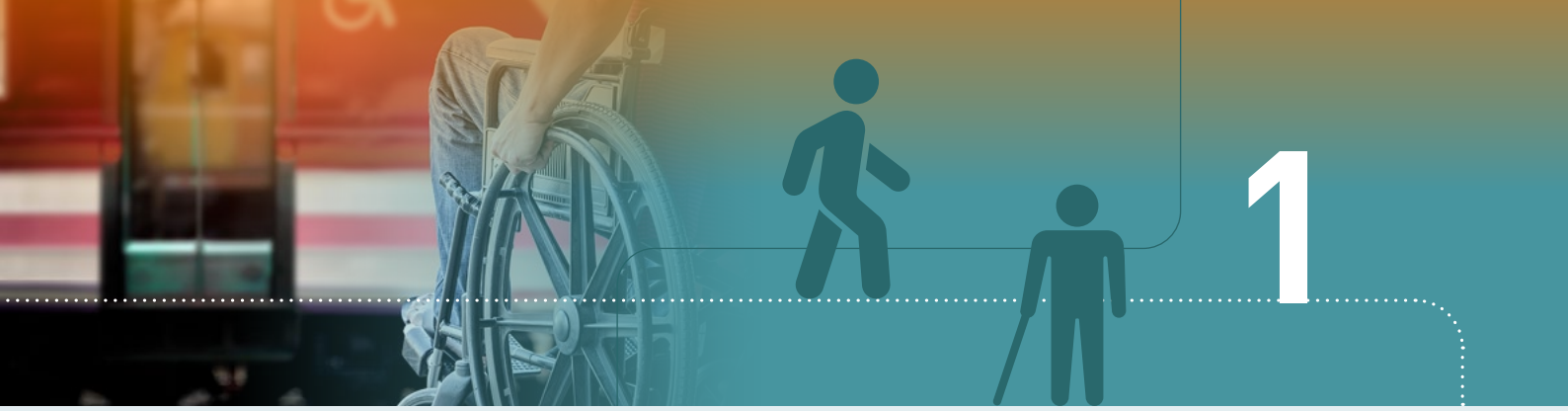
Article 3, **'Universal design and barriers to using public transport**, aims to deepen the understanding of how the transport system is perceived by different groups of people, and to understand and foresee challenges, weigh up the various issues, and facilitate good solutions that benefit as many people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



1

Inclusive mobility

KJERSTI VISNES ØKSENHOLT AND NILS FEARNLEY

This article is intended to provide readers with a backdrop for the other articles in this collection. We describe what is meant by an inclusive society and give a historical view of how people with disabilities have been treated and how legislation has evolved. We describe the concept of 'mobility' and how it is used in this collection of articles. We also describe the background to universal design and explain why it poses a particular challenge in public transport.

Kjersti Visnes Øksenholt

Kjersti Visnes Øksenholt is a human geographer and former senior researcher at the Institute of Transport Economics. She has worked for several years on integrated land use and transport planning, regional and urban development and universal design.

Nils Fearnley

Nils Fearnley is a transport economist and senior researcher at the Institute of Transport Economics' Markets and Governance group. Since 2009, he has been working on universal design and public transport through a number of projects for the Norwegian Public Roads Administration, the Norwegian Directorate for Children, Youth and Family Affairs (Bufdir) and its predecessor, Deltasenteret. Fearnley has a particular focus on demand effects, preferences and socioeconomic analysis in relation to universal design.

1. An inclusive society

Society as a concept can be used both on a political and a society is often perceived as synonymous with a national state, while in social science it is more often analysed as a social system (Store norske leksikon). In this collection of articles, society will be discussed both as a social system and in the context of inclusion, belonging etc., and as a political system with laws, regulations and requirements. To *include* means 'comprise or contain as part of a whole'(Oxford dictionary). Even though this is a similar definition to the concept of *integrate*, it differs in meaning in that in integration, it is the individual who must adapt to the community, while the basis of inclusion is an understanding that the community consists of and must be adapted to all its members. An inclusive society can also be linked to both well-being and equality.

Well-being is linked to the individual, and according to Allardt (1975), can be divided into three different fundamental needs: *to have, to love, to be*. *To have* is linked to an individual's material goods and resources. *To love* is linked to an individual's social relationships, such as friendship, love and intimacy. *To be* is linked to an individual's opportunity for self-realisation. These categories are not mutually exclusive, and resources and values can be placed in several of these categories at the same time. Nordbakke and Skollerud (2016) exemplify this by pointing out that employment serves not only as a source of income but also plays a crucial role in self-realisation. For some individuals, paid work can therefore encompass both to have and to be.

'Equality means that all people have the same fundamental human value, while equal rights imply that all people shall be given the same opportunities'

Equality is closely linked to the view of humanity. Lid (2013) defines the view of humanity based on two, non-mutually exclusive understandings: that people are fundamentally alike and that people are fundamentally different. The idea that people are fundamentally different pertains to personal factors such as interests, desires, personality, etc. No two individuals are alike, we are all unique in our presence here on earth. At the same time, we can understand people as fundamentally alike in the sense that all individuals ought to have the same rights and opportunities to live their lives according to their own wishes, regardless of bodily, cultural and social factors. '*The* way we live *with our individual qualities and limitations is fundamentally important and contributes to making each and every one of us the human being we are, different from everyone else and equal to everyone else.' (*Lid, 2013:76; own translation) The notion of equal status comes under the latter understanding. '*Equal status means that all people have the same fundamental human value, while equal rights imply that all people shall be given the same opportunities.'* (Lid, 2013:17; own translation)

The UN Convention on the Rights of Persons with Disabilities (CRPD)) gives clear guidelines about the rights of people with disabilities in terms of, for example, inherent dignity and individual autonomy, non-discrimination, participation and inclusion in society, equal rights and opportunities, and accessibility. Norway ratified this convention in 2013, and is thus also bound to follow the guidance given and work to achieve the objectives of the convention.

The purpose of the convention is to *'promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity'* (article 1).

1.1 From an individual-based to a relational understanding of disabilities

In order to deepen the reader's understanding of universal design, it is useful to provide an introduction to how the view of humanity and the perspective on people with disabilities have changed over time, and how this is expressed through official documents, legislation, etc.

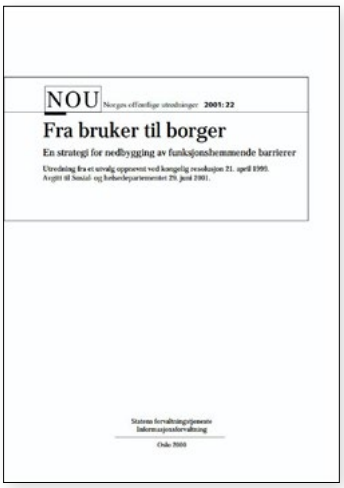
Historically, Norwegian society cannot be said to have been grounded on values such as equal status and equal rights (for a historical overview, see White Paper no. 88 – 1966-67 and the Norwegian Association of the Disabled 2005). Previously, people with disabilities were defined on the basis of, and reduced to, a medical interpretation – that the persons themselves have and experience a disability. It was not uncommon for people with disabilities to be separated from the rest of society. One example of this is found in the 1881 act on 'education for abnormal children', where compulsory schooling was introduced for deaf, blind and retarded children (sic.). *'According to the understanding at the time, children with serious disabilities should preferably be taught in separate institutions, and it was regarded as a duty of the state to establish special schools'* (White Paper no. 88 – 1966-67, p.5). At that time, there was no definition of types of disabilities and

the extent of these, but individuals who experienced the same challenges were grouped together and received special interventions. A common theme was that the 'treatment' they received was often being placed in institutions *'that could look after and care for them and make life as easy as possible'* (ibid, p.5). The introduction of social security in 1916 improved conditions for many people with disabilities, however this public intervention was extremely limited and mainly covered the blind and crippled (sic.) – *'persons with congenital or acquired defects or diseases in the arms, back or legs'* (ibid, p.5). This illustrates the individual-based understanding at the time that targeted measures which strengthened each person's individual capabilities and contributed to a better quality of life and opportunities through rehabilitation and treatment, were preferable (Lid, 2013).

In the 1960s, this individual-based understanding and approach began to receive criticism. It was not necessarily the need for rehabilitation and treatment that was undermined, but rather that people were defined and categorised in relation to each other, based on bodily characteristics. People with disabilities experienced discrimination and felt that they were not regarded as equal members of society (Lid, 2013). 1960 saw the introduction of legislation on disability benefit and rehabilitation. This did not view a person solely in terms of bodily functions, but also as an individual *'as a social being in their social and productive context'* (White Paper no. 88 – 1966-67, p. 7). A focus on disability being a result of external circumstances, and as such created by society through physical, social and cultural barriers, began to emerge. One of the objectives in the aforementioned White Paper was the principle of 'normalisation' in which society should be adapted to people with disabilities in order for them to experience the same standard of living and freedom of choice, rather than expecting the individual to adapt to society.

The relational understanding of the concept of disability, that it is a result of the environment and not of an individual's characteristics, increasingly gained foothold. However, Söder (1999, cited in NOU 2001) claimed that even if this understanding was the basis of a number of research projects and reports, in reality, there is often a tendency to revert to describing and analysing the characteristics of individuals. So people still seemed to be somewhat stuck in the past and the 'old way of thinking'.

The Norwegian Official Report (NOU) 'From user to citizen' (in Norwegian: 'Fra bruker til borger') was published in 2001. This reported on the rights of people with disabilities in a larger context and assessed and proposed a number of strategies and measures to promote participation and equality in Norwegian society (NOU, 2001). The committee also states that it *'in principle gives its support to a relational understanding of the concept of disability'* (NOU, 2001:8; own translation). That same year, the World Health Organisation (WHO) adopted the *International Classification of Functioning, Disability and Health*. This classification system meant that the emphasis was no longer on disease and diagnosis, but on each individual's functional ability in the context of environmental factors (Directorate of Health, 2018).


NOU

Fra bruker til borger

En strategi for nedbygging av funksjonshemmende barrierer

In this period, the Norwegian Association of the Disabled (2005) changed their focus from a fight for rights to a fight for equality.

The UN Convention on the Rights of Persons with Disabilities (CRPD) was passed in 2006, entered into force in 2008 and was ratified by Norway in 2013. The UN Convention defines persons with disabilities to 'include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others' (Article 1)

The legislation on discrimination and accessibility, which entered into force in Norway in 2009, gave people with disabilities protection against discrimination for the first time. The law prohibited discrimination of persons with disabilities in education, employment and other areas of society. The objective of the law was to *'promote equal status and equal rights, safeguard equal opportunities for participation in society for all, irrespective of functional ability, and prevent discrimination on the grounds of disability. The legislation shall contribute to the dismantling of socially constructed barriers and prevent new ones from being created'.*

In 2018, this legislation was replaced by the Equality and Anti-Discrimination Act, the objective of which is to

'promote equality and prevent discrimination on the basis of gender, pregnancy, parental leave, care responsibilities, ethnicity, religion, belief, disability, sexual orientation, gender identity, gender expression, age or other significant characteristics of a person [...]This Act shall help to dismantle disabling barriers created by society and prevent new ones from being created'.

Even though people with disabilities no longer have 'their own' discrimination and accessibility legislation, it can be argued that the changes in the law are a sign of progress because of the increasing emphasis on equal status, equal opportunities and equal rights for all potentially vulnerable persons. People with disabilities are thus included in a broader conceptual understanding and are placed on equal terms with other people who may potentially also experience situational discrimination.

When this collection of articles refers to people with disabilities, this includes persons with reduced mobility, sight and hearing, cognitive and psychosocial disabilities, as well as asthma and allergies, unless otherwise specified. However, this does not exclude persons who do not fit into any of these definitions but who nevertheless encounter disabling barriers.

2. Mobility

Mobility is a concept with many different definitions.

- Mobility can be physical and geographic, and is understood as the ability to move between different destinations as easily and quickly as possible (Freudendal-Pedersen, Hannam, and Kesselring, 2016).
- Mobility can also be social and is understood as a social practice and how this fits together in a system (Sheller and Urry, 2016). It can be understood both in a macro and micro perspective, where the former relates to major social processes such as economic restructuring, social polarisation and development, and the latter is of a personal nature and relates to movement in, for example, employment or the housing market (Easthope, 2009).
- Mobility can be technological and be understood as the opportunity to access or share information across continents and cultures (Sheller and Urry, 2006) and to communicate with others based on new technology that reduces or removes time and space barriers (Green, 2006).

These classifications are not static and exclusive, they are overlapping and based on individual frameworks and interpretations. One example is gender and transport, which can be understood and analysed both in terms of how physical transportation varies according to sex and how the opportunity for movement varies depending on gender, culture and social norms (Uteng and Cresswell, 2008). Sheller and Urry (2016:12) state that *'the scope of mobilities research goes far beyond physical transportation, to map and follow physical and virtual terrains of interconnected systems of uneven mobilities and immobilities of many kinds'.* 1

An example of the broad reach of the concept of mobility can be found by looking at the number of citations of Sheller and Urry's (2006) well-known article 'The new mobilities paradigm'. By 2016, the article had generated over 660 citations in the Web of Science (as per November 2023 it has over 7000 citations according to Google Scholar), and has been referenced in articles about '*ageing, new media, education, security, borders, risk, criminal economy, sport, citizenship, geopolitics, cosmopolitanism, disability, landscape, infrastructures, architecture, surveillance, energy, gender, consumerism, sustainability, globalization, transnationalism, development, complexity, social theory, climate change, social work, planning, management and social science methods, among others*' (Sheller and Urry, 2016:14).

Even though equality, inclusion and social participation are interpreted and defined in different ways, they include being treated in the same way as others, having the same opportunities, having a good life (Rioux and Valentine, 2006) and being an equal participant in society (Lid, 2015). Some feel that participation in different social arenas has increased with the growth of the Internet, social media and other digital platforms (Sépulchre, 2018). Even if digital media are a step on the path to increased inclusion, physical mobility is a prerequisite to achieving rights, equality, inclusion and participation in society. In order to be a fully-fledged member of society, individuals are dependent on physical mobility to varying degrees, both in terms of the job market and their social life.

A number of studies have found that reduced mobility can create social exclusion/outsiderness (Cass et al., 2005, Priya and Uteng ,2009), and people with different types and degrees of permanent or temporary disabilities constitute a group that often experiences this (Barnes and Mercer, 2005, Casas, 2007).

Even if digital media are a step on the path to increased inclusion, physical mobility is a prerequisite to achieving rights, equality, inclusion and participation in society.

Data from the Norwegian National Travel Survey (NTS) show that, in 2013/14, 9% of respondents had physical problems that limited their opportunities for moving around outdoors or using any means of transport. The corresponding figure in 2018/19 was 10% (Hjorthol, Engebretsen and Uteng, 2014, Gregersen and Langset, 2021). The question is phrased in such a way that it catches those with temporary and those with long-term/permanent reduced mobility. The respondents say that the main issue is difficulties with walking and cycling (Table 1). Even though fewer report difficulties with public transport, it is important to remember that a journey by public transport also includes the walk to and from stops and stations at each end. Gregersen and Langset (2021) further find that persons who answered yes to the above question make fewer journeys per day than the rest of the population, even when adjusted for the time of year, access to a car and place of residence.

When reading the table below it is important to remember that the NTS figures are based on an individual-based understanding of disabilities, where the respondents are asked whether they have any physical challenges that make travelling difficult for them. Respondents are not asked whether *the transport system* is adapted to their needs, so this is not based on a relational understanding.

Table 1: Those who have physical difficulties with moving around outdoors or using means of transport experience problems linked to the following transport methods (percentage). Data from the Norwegian National Trael Survey (RVU) 2013/14 and 2018/19

NTS 2013-14 AND 2019, WEIGHTED	PROPORTION OF THOSE WITH DIFFICULTIES, PERCENT	
Do these problems make it difficult for you to ...	2013/14	2018/19
... walk?	77	81
... cycle?	67	71
... fly?	24	18
... travel with other means of public transport?	33	29
...travel in a car as a passenger?	14	6
... drive a car yourself?	29	24

In this article the concept of mobility is based on a physical and geographical understanding unless otherwise specified. We will include and refer to studies that are based on both the individual-based and the relational understanding of the concept of disability, since the results from both types of study may be educational in their own way.

2.1 Mobility as a chosen action

Mobility can be understood as a result of a person's actions. A person's actions are based on their wishes, needs and actual or perceived opportunities (Elster, 1989, Nordbakke, 2014). Mobility thus depends on both the wishes and needs of a person, but also their perception of their opportunities for moving from one place to another.

Jones (1987) divides mobility into three different components. 'Individual actions' are the actual journeys that are undertaken. 'Potential actions' are the journeys that a person would like to be able to undertake, but that for various reasons cannot be undertaken. This could be as a result of limiting factors inherent in the transport system, but it could also be due to constraints linked to the individual, such as lack of time, financial resources, etc. 'The opportunity to action' refers to the journeys that may never be actually undertaken but which the individuals know they have the opportunity to undertake if they so wish.

Other researchers define mobility as opportunities for movement (Knie, 1997, cited in Uteng, 2006) and potential for movement rather than actual movement (Dunn, 1998). Kaufmann (2002) on the other hand, suggests three different factors that affect a person's mobility: whether they have access to transport resources; whether they have the skill to use the transport resources; and whether they actually do use the transport resources. Nordbakke (2014) divides a person's opportunities for mobility into 'individual resources and characteristics' and 'environmental factors'(shown in Figure 1). A person's resources and characteristics are defined as the physical, material, temporal and social resources a person has access to, that can promote mobility and participation in society.

These are factors that apply at an individual level. Environmental factors relate to the surroundings that affect the Individual, and can be defined as the social, temporal and spatial characteristics that promote or prevent a person's mobility. Together they constitute a person's opportunities for mobility, both actual and imagined, and along with needs, wishes and preferences, they will affect every individual's actions and, in turn, their mobility.

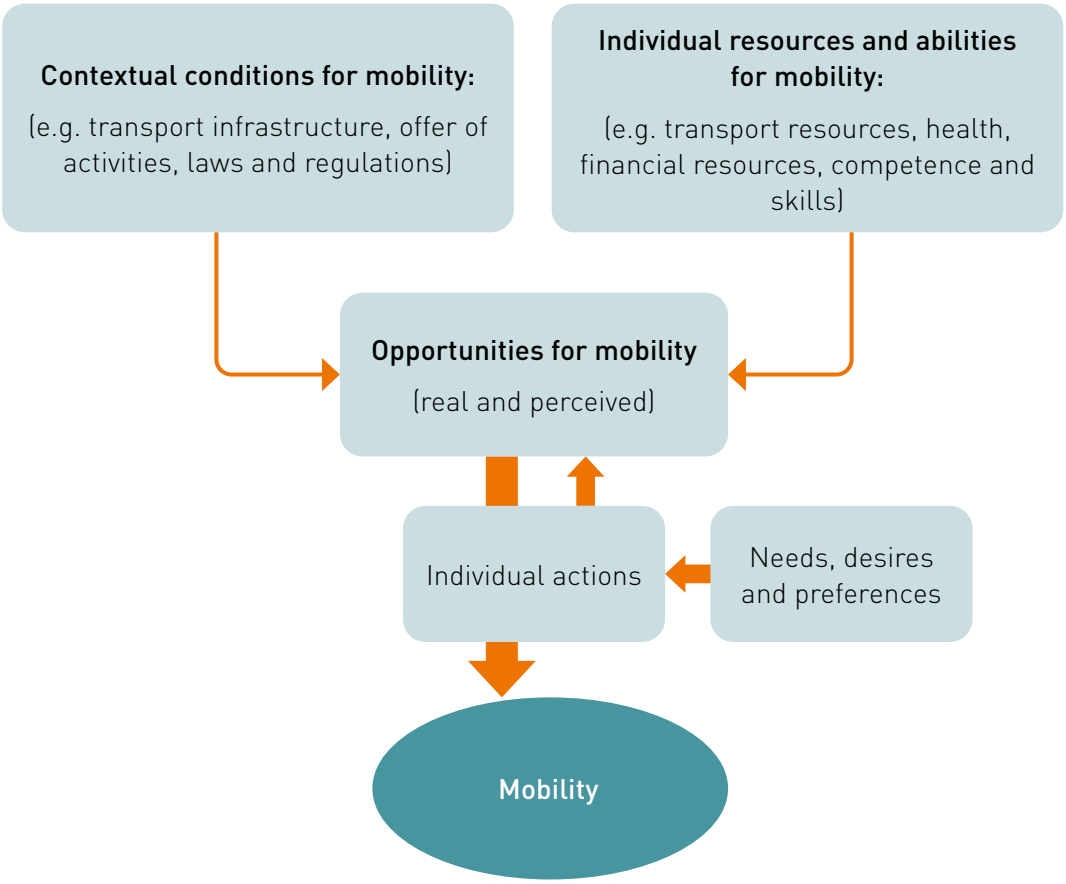


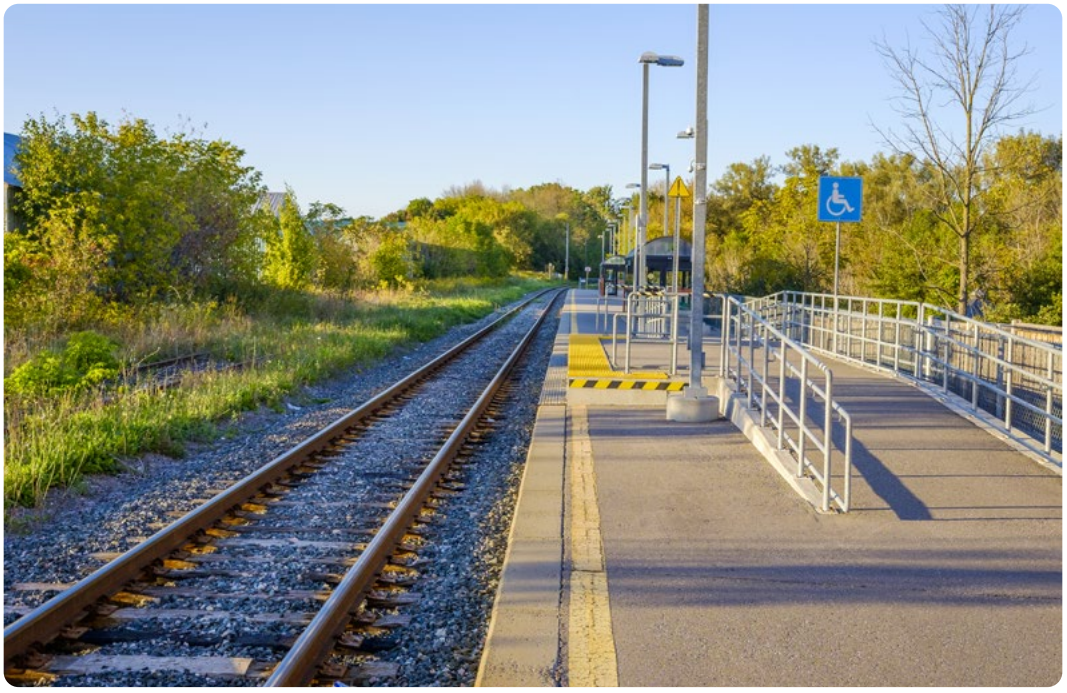
Figure 1: Factors that affect and shape mobility (Nordbakke, 2013, Figure 1).

In addition we can look at a person's travel needs as a result of their travel motivation. Mokhtarian et al. (2015) propose that a distinction be made between different travel behaviours as a result of internal and external factors. Internal factors affect travel behaviour in the sense that the journey in itself is a goal and a perceived benefit, while journeys affected by external factors will only be a means to achieving something else – i.e. the trip purpose. Even though, historically, most attention has been focused on journeys based on external factors, it is noted that not including internal factors will result in underestimating people's actual travel needs and benefits.

3. Universal design

When we use the term disability it is common to distinguish between its use in the context of individuals and when referring to barriers in the environment. On an individual level, the term *disability* is used to describe an individual who has permanent or temporary impaired functionality in physical, mental or cognitive capacities, e.g., loss of or damage to a body part or sensory function.

Disabling barriers, on the other hand, are linked to environmental factors that hinder activity and participation, the premise being that the disability is not a result of an individual's permanent or temporary impairment but rather of the gap between an individual's needs and the inadequate design of the environment. This is in line with the UN Convention (CRPD, Preamble (e)), which states that '*disability is an evolving concept and that disability results from the interaction between persons with impairments and attitudinal and environmental barriers that hinders their full and effective participation in society on an equal basis with others*'.



Universal design is intended to reduce disabling barriers and to help ensure that the environment no longer impedes participation in society.

Universal design is thus about physical solutions or designs reducing the significance of individual capabilities (Øvstedal, 2009), and about creating solutions that help maximise accessibility, human diversity and equal opportunities for participation in society (Lid, 2013).

The concept of universal design was first raised by the architect Ronald Mace (1985). In Norway, the concept was first used in the 1997 report 'Universal design. Planning and design for all', and was defined as '*the design of products and environments in such a way that they can be used by all people to the greatest extent possible without the*

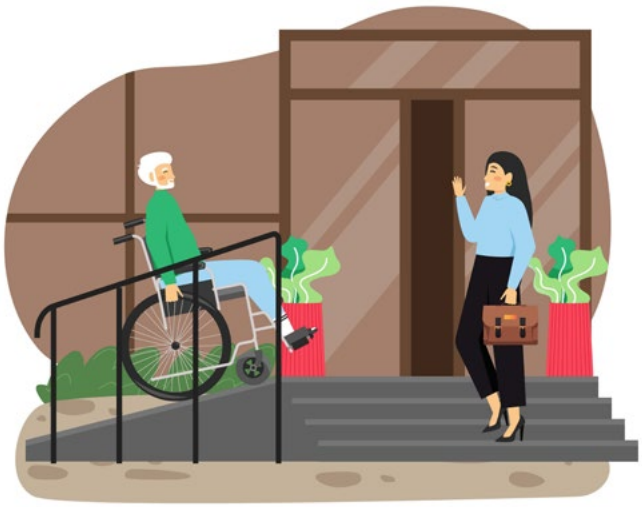
need for adaptation or special design'(Aslaksen et al., 1997:4). Here, universal design is presented as a strategy for designing usable environments for every human being, irrespective of age, size and level of functionality. Aslaksen et al. emphasise that planning should have a sharper focus on solutions that benefit everyone, rather than changing paradigms that focus on children, women, older age groups, etc.

The Syse committee's 2005 definition of universal design is one often used in Norway: '*Universal design means designing or accommodating the main solution with respect to the physical conditions, such that the general functions of the undertaking can be used by as many people as possible'* (NOU, 2005:8). The Syse committee's definition of universal design gives room for a certain flexibility. By stating that universal design is not intended to accommodate absolutely everyone, but as many as possible, the committee delimits the concept whilst simultaneously requiring a more detailed specification of who the target group really consists of and what user prerequisites universal design should address. In this way, special solutions that guarantee accessibility but that are not strictly speaking universal design are also accepted (Fearnley et al., 2015). This definition has been further developed and used in Norwegian legislation:

'Universal design means designing or accommodating the main solution with respect to the physical conditions, including information and communications technology (ICT), such that the general functions of the undertaking can be used by as many people as possible, regardless of disability' (Ministry of Children and Equality, 2017, Section 17)

In the UN Convention on the Rights of Persons with Disabilities (CRPD, article 2) universal design is defined 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.*'

In Norway, universal design can be described and interpreted as a vision, a strategy, an instrument and a technical term (Lid, 2013). It can be a vision of a society that includes everyone and where everyone has the opportunity to participate on equal terms. It can be a strategy for counteracting social exclusion and the segregation of groups and solutions. It can be an instrument for achieving the goal of every person being able to function as equal members of society, irrespective of age, level of functionality and type of disability. And it can be a technical term linked to the systematic and practical follow-up and implementation of the requirements for accessibility in legislation, manuals, and standards.



Lid (2013) further distinguishes between universal design on a macro, meso and micro level. On a macro level, universal design can be seen as a strategy that is expressed through statutory objectives and political principles; on a meso level it is

enacted and expressed in standards and technical and physical solutions. On a micro level we find the users' experiences of quality, accessibility and usability.

Wågø et al. (2006) distinguish between universal design, accessibility and access to buildings and public transport vehicles, which can be illustrated by a fictitious building and a fictitious wheelchair user. If the wheelchair user has to use another entrance (basement door, back door, staff entrance, etc.) they will have *access to* the building, but the solution can be regarded as discriminatory. If the building has a wheelchair ramp leading to the main entrance, the building is *accessible* to all. Accessibility thus implies special solutions that make it possible for a person with limited mobility to cross barriers or visit a particular establishment. If the building has been designed in such a way that it allows everyone to use the main entrance on the same terms, it is *universally designed*. This could for example be if the area around the main entrance has been designed in such a way that everyone has step-free access, or a solution consisting of both steps and step-free access (using similar materials) designed in such a way that it appears completely random which option is chosen.

However, universal design does not mean that everyone *must* have the same access to absolutely everything, and aesthetic considerations must still be taken into account. One example of this is highlighted by Lid (2013), who describes the stairs located at Festplassen in Bergen, towards the lake Lille Lungegårdsvann. Some argue that these stairs breach the principles of universal design since they lack safety markings for people with visual impairments and are not accessible for some people with disabilities, e.g. wheelchair users. On the other hand, it can be argued that the stairs bring an aesthetic quality to the square, and are not part of the 'general function'. This case was brought before the Anti-Discrimination Tribunal (case no. 45/2010, pp. 8-9), who concluded that '*Festplassen must be regarded as a whole. As such, it is aimed at the general public and is accessible to all. The complaint concerns a part of the square which constitutes 7% of the whole site and does not form a central part of the area used by the public. The steps leading down to the water are used for sitting on and are, in the tribunal's view, a decorative element that contributes to the aesthetic appeal of the square as it descends towards the water. They are not built as an*

area for vehicles, they do not represent an access path, and they have no central function in relation to arrangements held at Festplassen. […] The tribunal therefore concludes that the stairs neither constitute a main solution in the physical surroundings nor form part of the general function of the space, and that there should be no requirement for the steps to be universally designed'. This illustrates the fact that infrastructure defined as universally designed is not necessarily something that can be used by everybody. We will discuss this further a little later

3.1 Universal design in public transport

Streets, squares and public transport are shared facilities that every member of society should be able to use. The aim is therefore to adapt them for as many people as possible. Universal design in public transport places requirements on vehicles, transport hubs and stops as well as ticketing and information systems. Every one of these must meet requirements (established through standards and guidelines) and adhere to design principles for universal design, and they need to function in conjunction with the other factors. Predictability and step-free boarding as well as enabling the visually impaired to board the right vehicle, place requirements on vehicles, stops and platforms and for vehicles to stop at a given place at a stop or platform. This goes for every single vehicle and every single stop or platform that intersect. Bus drivers approaching a stop should pull in close to the kerb and ensure that any tactile lead lines align with the entrance door beside them. These examples show that the passage between the built environment and the vehicle can be challenging from a universal design perspective. In addition, the access to and from stops and platforms must also follow the principles of universal design.

The 1998 'Action plan for persons with disabilities' describes (to our knowledge) for the first time the principle of sectoral responsibility. This principle entails that each authority is responsible for making the adaptations needed for people with disabilities to use services on equal terms with the rest of the population, and that these same authorities are responsible for supplementing special arrangements if necessary (Ministry of Labour and Social Inclusion, 1998). This is an important principle which still stands. Today, many different actors (local authorities, county authorities, transport companies, the Norwegian Public Roads Administration, the Norwegian Railway Directorate, Bane Nor, the Norwegian Coastal Administration, the Norwegian Maritime Authority, etc.) have their own areas of responsibility within the principle of sectoral responsibility which shall ensure that the functional requirements linked to the footways leading to stops and stations, information, the stops and stations themselves, ticketing, and the vehicles are maintained and work well together. The fact that different actors are responsible for different parts of the trip chain can make it challenging to maintain universal design throughout the whole chain. According to the Delta centre (2003), many people experience breaks in the trip chain. In addition, there is enormous variation in the different scope and types of functional requirements, and they can also be contradictory (Skjerdal, 2005, Øksenholt and Aarhaug, 2018). Having to interact with bus drivers or other personnel can also be a challenge for some people (Aarhaug and Elvebakk, 2012, Øksenholt and Aarhaug, 2015). This happens despite bus drivers saying that they are encouraged by their employers to prioritise service over punctuality (Krogstad et al., 2019). All this makes universal design in public transport a complex issue.

The fact that different actors are responsible for different parts of the trip chain can make it challenging to maintain universal design throughout the whole chain.

Also in public transport, a distinction can be made between universal design and accessibility. The access to and use of a product may be the same for users with differing characteristics irrespective of whether the product is universally designed or accessible. A bus that does not have a low floor entrance, but which does have a lift and thus enables a wheelchair user to board it, is not universally designed, but it has a special solution that makes it accessible (Fearnley et al., 2015). However, several Norwegian towns and cities have developed an 'in-between solution', where low-floor buses with step-free boarding are used at bus stops that are also universally designed, and where a manual ramp can be used at stops that do not adhere to a universal design standard. A wheelchair user will thus be able to use all the three described solutions, but they will be dependent on the driver or fellow passengers to board the bus when using a lift or a manual ramp. A bus with a low floor entrance will make it easier, quicker and more comfortable for other groups to board and alight the vehicle, such as parents with prams, passengers with heavy luggage or older people who have difficulties walking. The faster boarding and alighting will also reduce the time spent at each stop, which is beneficial to the operators as well as the other passengers (Fearnley et al., 2010). Collectively, this is part of the reason why universal design has been found to be socioeconomically viable in many instances (Odeck et al., 2010; see also article 6 in this book). However, many other countries, including the UK, have gone for an 'accessibility for all' approach, which both accepts and partly favours adaptations and special fittings such as ramps and lifts rather than the Norwegian strategy of universal design.

The White Paper 'Better public transport' (Ministry of Transport, 2002:31) emphasises that *'persons with limited mobility who use transport services shall first and foremost be served through adaptation of the ordinary transport system'*, and that special solutions will be additional to that. The principle of sectoral responsibility is also mentioned in the White Paper in connection with the implementation of accessibility measures in public transport, and that the principle of universal design shall be a fundamental element linked to infrastructure and vehicles. During the period 2006-2009, the Ministry of Transport funded an accessibility programme, which was intended to contribute to better accessibility in public transport. Funding for measures was based on a minimum of 25% local co-financing (Aarhaug et al., 2012). This initiative was continued as a government grant scheme for 'better accessibility in public transport', with the same self-financing requirement, through the Ministry of Transport 's budget until 2015.

The grant scheme part-funded municipal and county initiatives to upgrade public transport infrastructure. The objective was to expedite and improve the coordinated effort by all actors to improve accessibility in public transport. The scheme was administered by the Norwegian Public Roads Administration. A before and after survey of selected initiatives that received funding through this scheme shows that the initiatives were well received by people with disabilities, other passengers and drivers. However, the grant scheme did not cover initiatives that covered the whole trip chain, which meant that it was not possible to eliminate all the challenges faced by public transport passengers. These challenges are particularly linked to information about the measures, maintenance, and the drivers' knowledge of the needs of people with disabilities (Aarhaug and Elvebakk, 2012).

During the period 2007-2015 and in parallel with this scheme, rural areas had access to funding from KID (Public Transport in Rural Areas), which funded 50% of public transport measures in rural areas. The county authorities mainly used this funding to prioritise infrastructure in the work on universal design, such as vehicles, transport hubs and stops, as well as ticketing and information systems (Krogstad, 2015).

The majority has already been built

In addition to the inherent challenges of universal design of public transport, it becomes even more challenging when we take into account the vast number of stops and transport hubs around the country. According to Entur, there are more than 58,000 public transport stops in Norway[1], and a large number of stops and platforms are not yet universally designed. In 2015, 103 of the country's 337 railway stations were classed as 'accessible', while 10 were 'universally designed'. In addition,

1 https://om.entur.no/bedrift/om-entur (visited in November 2023).

another four stations were expected to be given universal design status during that same year (Norwegian National Rail Administration, 2016). During the period 2012-2016, 488 bus stops along Norwegian national roads were upgraded to universal design standard, while 28 public transport hubs were upgraded (Norwegian Public Roads Administration, 2017). We have not found any figures for stops along county and municipal roads.

The report 'From user to citizen' (NOU 2001:460) concludes that *'[...] it will be cost-effective to introduce a standards requirement for the needs of persons with disabilities to be taken into consideration ahead of new investments. A requirement for all public transport and all public buildings to be fully accessible within a short period of time will be disproportionally expensive'.*

It further states that even though such a requirement may be well grounded, based on the fairness principle, the costs cannot be justified.

However, a requirement for public transport and buildings to be universally designed can be sensible if this is viewed within a longer perspective and gradually introduced through new investment and major refurbishment. This attitude and understanding of universal design still guides transport policy in Norway (Odeck et al., 2010; Tennøy et al., 2014). Meanwhile, both public and private undertakings aimed at the general public have an obligation to ensure that their general functions adhere to universal design standards, see Section 17 of the Equality and Anti-Discrimination Act.

Previous studies indicate that even if society were to follow the planning and design principles of universal design to the letter, there will always be some who find themselves not included in the initiatives and standardised solutions (Øksenholt and Aarhaug, 2018). The current policy and strategy relating to universal design do not therefore provide for a society which is so accessible that disabilities become irrelevant – something that in principle is also in line with the definition of universal design. *'The idea that universal design guarantees accessibility for all is misleading, because human diversity is so great and the barriers so different that several approaches and solutions are required to create an inclusive society.'* (Lid, 2013:152)

A range of different aids is available for those who are either unable to use regular public transport or have other adaptation requirements, such as an adapted car, adapted transport solutions, etc. However, even with access to such aids, an individual may not necessarily have full mobility in society. Someone who has an adapted car, but who for various reasons cannot use public transport, cannot, for example, choose to have a glass of wine with a meal and then take the bus home. Someone receiving 'support for travel in connection with employment and education' cannot choose to join colleagues for dinner after a day at work without 'losing' a journey. Persons who have been approved for a variant of adapted transport solutions may not receive the level of aid that they actually need, which means they are unable to use any type of adapted transport solutions. The daily transport needs will also not be met for people who are unable to use regular public transport and do not have access to aids. This may have considerable personal and social consequences. It can reduce both their sense of freedom and their actual freedom, making them feel 'trapped' at home. It can also lead to them not feeling like they are part of or actually able to participate in society on the same terms as others. This is problematic both on an individual and a societal level since it contributes to reduced inclusion and participation in society.

4. Universal design is important

Even though universal design cannot reach *everyone* it is still worth striving for. It is important to keep working to maximise the number of people having the best possible mobility and society being as inclusive as possible. Universal design is an important strategy in this work and an important guide for the right kind of thinking.

'Universal design is therefore not first and foremost a finished product, but a process where experience influences the understanding of what should be done and thus what it is possible to achieve [...] The task is to do the best we can, and strive for ever better and more inclusive understandings' (Lid, 2013:86; our translation). Universal design as a vision strengthens the focus on holistic solutions that encompass as many people as possible rather than measures that only cater to the needs of certain groups. A society that continually strives to maximise inclusion through universal design and accommodates those who for various reasons are unable to use these solutions will promote increased participation in the labour market and in society in general. This is a society that takes care of its citizens on an individual level and helps each and every one of them to make the most of their potential so that they can contribute to increased welfare and value creation in society. Only then can society exploit the potential inherent in every citizen whilst also safeguarding inclusion and equality (Øksenholt and Aarhaug, 2018).

5. Further reading

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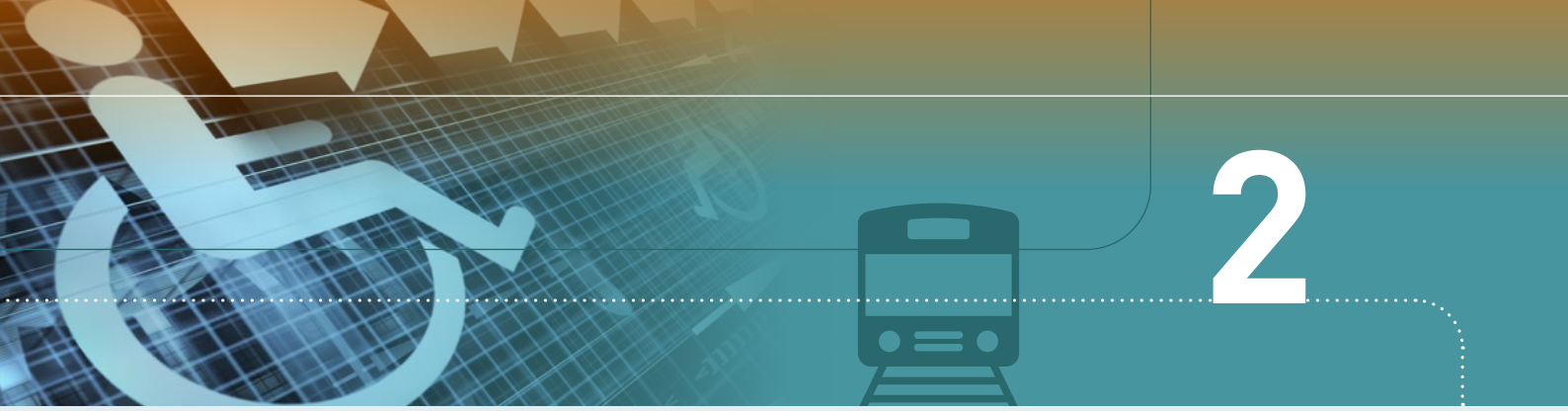


2

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.

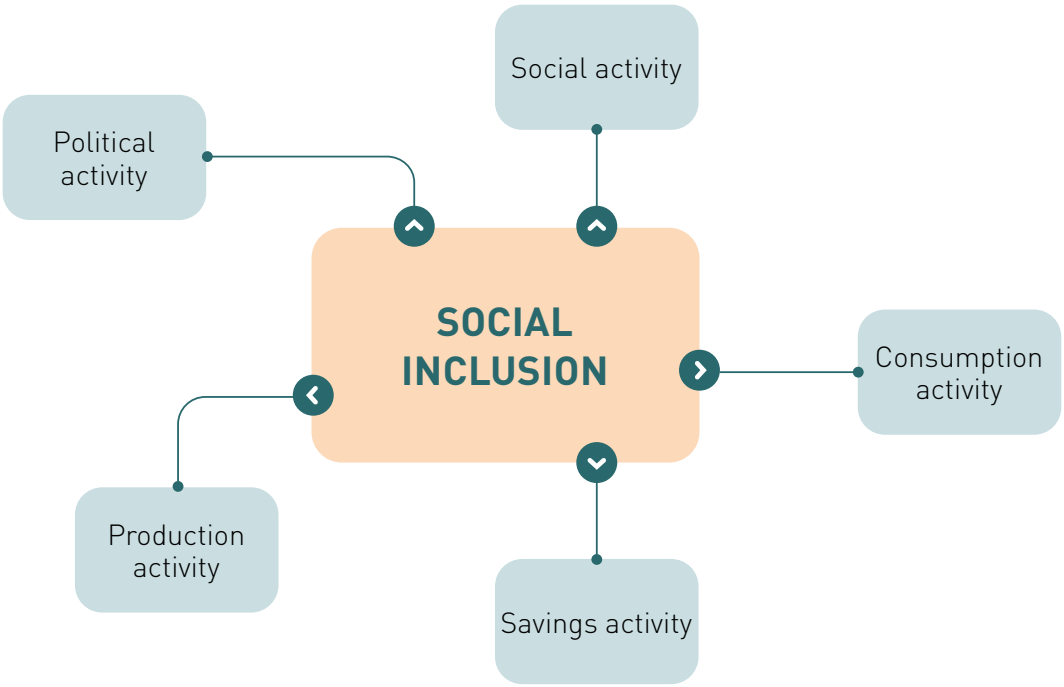
Consumption activity is the ability to buy and take into use a minimum level of goods and services considered normal in a given society.

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.'

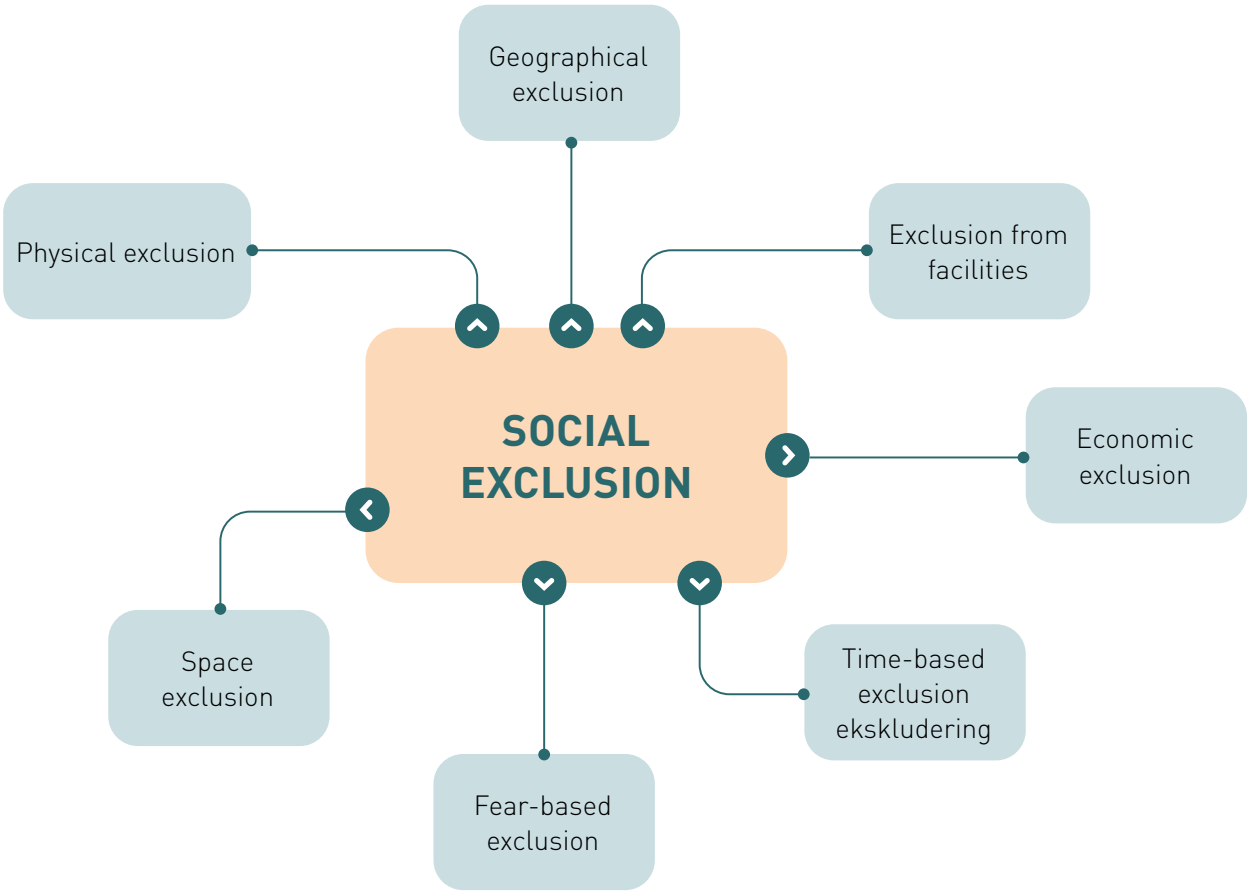
However, the relationship between transport and social inclusion is multifaceted, and the literature includes different understandings of how transport strengthens or weakens inclusion. According to Schwanen et all. (2015), inadequate transport provision is a result of i) a lack of resources, ii) a lack 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.

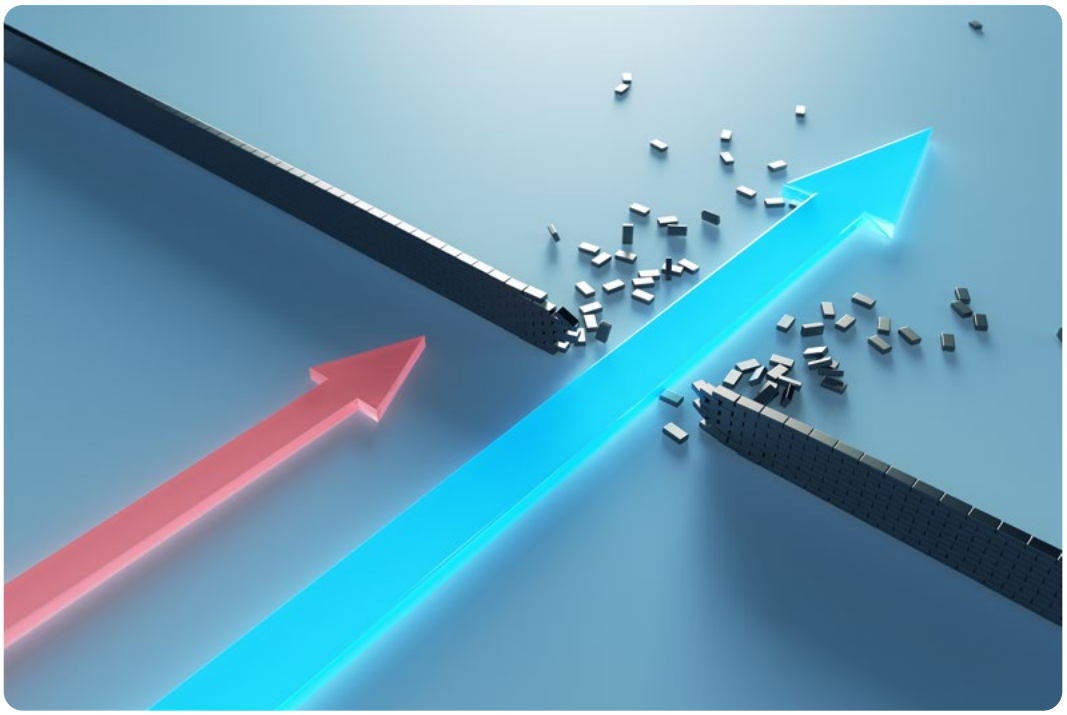
2.2 Identification of functional requirements

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.

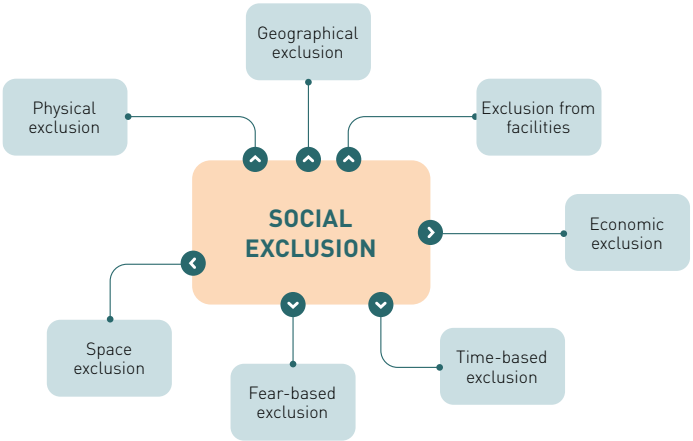
8 Short, predictable travel times

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).

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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

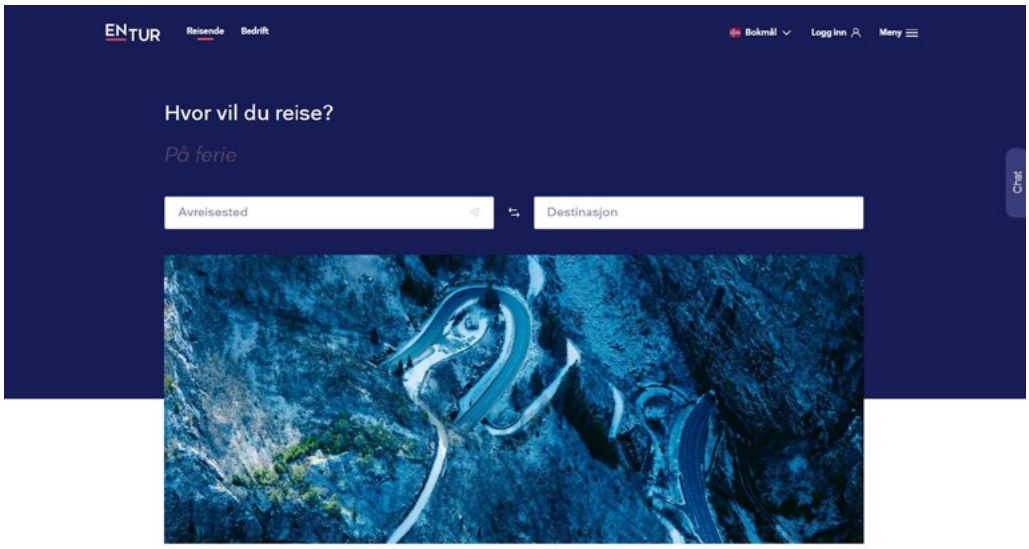
Part 3 discussed functional requirements that transport solutions should address to facilitate social inclusion among people with disabilities. In order to meet the functional requirements, the provider of the transport solution must be aware of these requirements and establish strategies to address 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.

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3

Universal design and barriers to using public transport

ANJA FLETEN NIELSEN AND KJERSTI VISNES ØKSENHOLT

This chapter seeks to explain how the transport system is experienced by different groups of people, and to make it easier to understand and foresee challenges that may arise, weigh up the various issues that must be considered, and facilitate good solutions that benefit as many people as possible. The goal is for everyone who works in planning to look afresh and critically at universal design, and that they make it a habit to ask, 'Could this intervention have a negative impact on people who are not in the specific target group?'

Anja Fleten Nielsen

Anja Nielsen studied health geography at the Norwegian University of Science and Technology (NTNU), Trondheim. She has been working in the field of universal design and transport for seven years, specialising on how people with psychosocial disabilities experience transport systems.

Kjersti Visnes Øksenholt

Kjersti Visnes Øksenholt is a human geographer and former senior researcher at the Institute of Transport Economics. She has worked for several years on integrated land use and transport planning, regional and urban development and universal design.

1. Barriers and interventions

A universally designed transport system is a vision and goal that has gained increasing acceptance in Norway. A key challenge for those who work to achieve universal design in the transport sector and elsewhere in society is to facilitate good solutions that can be used by a wide section of the population. Universal design is a strategy that aims to make it easier for everybody to travel, irrespective of age, height, size and level of functionality.

This chapter seeks to raise awareness of challenges and needs that are not commonly known. People with different types of disability may have very different adaptation needs. These do not always coincide; at times they even conflict. Barriers and potential solutions are described separately for each user group to give a broader understanding of how it is possible to plan, develop and operate a well-functioning transport system. To provide a comprehensive picture, the barriers presented are linked to impaired mobility, vision and hearing, allergy problems, and cognitive and mental health challenges. We recognise that people who do not fit into any of these groups can also encounter barriers to travel in our current system. When we refer to transport systems, our focus is generally on public transport (bus, train, tram, underground, taxi).

This article is not intended to provide an exhaustive list of travel barriers encountered by different groups of people, nor of what measures should be implemented and how. The objective is to help readers better understand how the transport system is experienced by certain groups, and to make it easier to understand and foresee various challenges that may arise, weigh up the issues that must be considered, and facilitate good solutions that benefit as many people as possible.

Our objective is for readers to look afresh and critically at universal design for transport systems, and that they adopt the habit of asking 'Could this intervention have a negative impact on people who are not specifically in the target group?' Universal design can at times be tricky, but our hope is that a better understanding of the various barriers and needs, and how these may conflict, will help to ensure that implemented measures are well-considered and that they take society a step further towards full universal design.

'Could this intervention have a negative impact on people who are not specifically in the target group?'

This chapter will describe barriers and potential interventions linked to various forms of disability. Neither the list of barriers nor the list of interventions is exhaustive. The same applies for the tables, which are intended to summarise the text and provide an overview of specific barriers and potential interventions. There are many more barriers and many more interventions that may address the problems.

2. Barriers associated with impaired mobility

In the course of our lives, many of us will have our mobility impaired. Mobility impairments can be temporary or permanent and can range from conditions like knee pain, a broken leg or balance problems, to pushing a pram or using a walker or a wheelchair. Not all types of physical impairment are visible to other people. Various rheumatic diseases and other conditions that cause severe pain (disc prolapse, endometriosis, etc.) will also cause considerable mobility difficulties. An increasingly aging population will make it even more important to focus on universal design, as old age causes greater physical problems for most of us.

It is important for people with impaired mobility that they encounter minimal **physical obstacles** (e.g. steps, steep hills, kerbs) on their way to and from bus and tram stops, and that any such obstacle is compensated for by measures such as lifts and ramps. If a ramp is integrated within the design of the physical environment in a way that makes it appear to be an equal option to steps, then this is an example of good universal design. Elsewhere it may be required to retrofit ramps over existing steps to ensure access for all. This would not be universal design, but an accessibility measure. Universal design must always be the first choice; accessibility measures are supplementary interventions where it is necessary to ensure access. It is also important that aids such as ramps and lifts are regularly maintained and that good winter service ensures that everyone can get around outdoors. In a survey undertaken

among people with impaired mobility, as many as 74% of respondents answered that they find it difficult to travel in winter, and that poor snow clearance, banks of snow, slippery surfaces and darkness are challenges that make travelling more difficult. Better winter servicing is therefore necessary to ensure good access for all throughout the year (Aarhaug et al., 2011; Hjorthol et al., 2013; Krogstad and Skartland, 2016; Nordbakke and Skollerud, 2016). When planning bus routes and distances between stops, it is important to ensure that the nearest bus stop is not too far away, as distance is a significant barrier for people with impaired mobility (Lodden, 2001; Nordbakke and Skollerud, 2016; Nordbakke and Hansson, 2009). Hjorthol et al. (2013) found that the elderly wanted more benches to allow them to rest along the way. This measure would improve the journey to and from the bus stop where stops are far apart.

It is important that there is enough seating at bus stops and in station areas so that waiting passengers who need to sit down can do so. In crowded stations, it can be difficult for drivers and conductors to identify whether passengers are in need of assistance. It is also challenging for passengers to see which train carriage is fitted with a lift if their sightline is obscured by crowds (Braarud, 2012; Krogstad and Skartland, 2016; Nordbakke and Skollerud, 2016).

Ease of **boarding and alighting** is also essential, as this is the biggest problem for people with impaired mobility. As many as 48% report getting on and off the vehicle as a problem when using public transport. Step-free boarding and alighting enable wheelchair users to get on and off the bus without depending on assistance from fellow passengers or the driver. Low-floor busses will also make boarding and alighting simpler for those with impaired balance or other mobility issues.

'48% report getting on and off the vehicle as a problem when using public transport.'

Low-floor and low-entry buses allow for faster boarding and alighting, but it is also important that the design and location of stops ensure a minimal gap between platform and vehicle. Raised bus stop platforms is a measure that makes it simpler for many to board the vehicle, particularly those who use a wheelchair or a walker (Rødseth, 2004; Aarhaug and Elvebakk, 2012; Krogstad and Skartland, 2016; Nordbakke and Skollerud, 2016).

On board the vehicle it is important that there is sufficient space for wheelchairs, that there are enough seats and that there is no overcrowding or erratic driving. Wheelchair users report that they have insufficient space to manoeuvre their chair on board vehicles; 40-45% have experienced this on buses and 75% on trains. Wheelchair users also find that there is insufficient space set aside for the wheelchair; 25-30 % have experienced this on buses, and 30% have experienced this on trains (Braarud, 2012).

It is important that **information**[1] is provided at different heights – both via high-level monitors that are mounted at a good angle, and low-level monitors for wheelchair users (some of whom may find it difficult to read from 'seat height'). Signposting of alternative entrances is important for people with impaired mobility. It is also important to ensure that information is provided during the journey. Because the sightlines of wheelchair users may be restricted, visual orientation may be difficult. Incorrect or non-existing (real-time) information can therefore cause people to lose awareness of where they are, so that they fail to alight at the correct stop. Ticket machines must be mounted at a height appropriate for wheelchair users, but screens should not be so low that those with balance impairments will find them difficult to read because of the need to bend down. Although there are statutory standards for the design and positioning of ticket machines, it is difficult to take on board all implications. Local light conditions can also add to the challenges and affect the user friendliness of the machine. A status survey conducted by The Authority for Universal Design of ICT found that approximately 50% of all self-service ticket machines are non-compliant with the requirements for universal design, and that more than a third do not comply with the requirements for access to service areas.[2] Staff that are on hand to assist with ticket purchases can also help to provide a better passenger experience (Aarhaug and Elvebakk, 2012; Kummenje et al., 2014; Krogstad and Skartland, 2016).

1 The regulations on universal design of ICT solutions provide definitions and requirement for the design of ICT.

2 https://www.uutilsynet.no/statusmalingar/tilgjengelige-automater-status-universell-utforming-av-selvbetjeningsautomater/937

Accessible toilet facilities are extremely important for those who travel by public transport. Although universal design of accessible toilets is a statutory requirement, there is often inadequate space on both sides of the toilet. Also, wall-mounted toilets are often shorter than the wheelchair – which may cause a risk of falling during the transfer. The positioning of flush buttons and paper dispensers also cause problems, as well as the use of disabled toilets as a storeroom (Norges Handikapforbund, 2012).

Table 1: Examples of barriers associated with impaired mobility, with suggested interventions.

BARRIERS ASSOCIATED WITH IMPAIRED MOBILITY	INTERVENTIONS
Steps, kerbs, steep hills	Lifts, ramps, signposting of alternative routes
Snow and ice	Good winter servicing
Long distances	Benches to allow rest
Boarding the vehicle	Low-floor and low-entry buses, raising the bus stop level, no large gaps between platform and vehicle
Space problems on board the vehicle	Sufficient number of seats, space to manoeuvre a wheelchair
Crowded platforms make it difficult to spot the accessible carriage	Platform audio/light indicator to notify staff that someone needs special assistance. Activated by push-button or app by the person who needs assistance.
Lack of information	Screens at different heights – low-level monitors as well as high-level monitors mounted at a good angle; visible, audible and updated information on board.
Access to toilets	That they exist and are not locked, enough space both sides of the toilet, avoid wall-mounted toilets, position flush button/dispensers, etc. at wheelchair height.

3. Barriers associated with impaired vision

WHO uses five categories of partially sighted/blind, ranging from moderate vision impairment (category 1) to complete loss of vision (category 5). These categories are based on visual acuity (at what distance you can see an object) and the size of the visual field (normally 180 degrees). Additionally, there is a category of unspecified visual impairment, which is often used when there is a severe problem that cannot be measured in the same way as the above categories (Blindeforbundet, 2019). In the course of our lives, most of us will experience impaired vision. The challenges we meet will differ depending on whether our acuity of vision is poor, our visual field is limited, our light perception is impaired or if there are other problems. Colour

impairment (not impaired eyesight) can make it difficult to differentiate between different shades of colour. Some need as much light as possible while others are highly sensitive to light. In combination, all of these issues make it challenging to find good solutions that suit everybody. Clear, logically laid out environments, good tonal contrasts, and the same information conveyed in several different ways (e.g. tactile features, audio, colours, pictograms) will aid most of these groups.

The blind and those with severe vision impairments often make use of a cane to *navigate,* and they rely on the navigability of their environment: simple and logical layouts, footways free of obstacles, lines/kerbs for guidance, and elements that can serve as landmarks are all important features. The more navigation clues there are, the simpler it is to follow a route. When the built environment naturally incorporates elements that the visually impaired can use for wayfinding (like kerbs along pavements and distinct differences of material), these are referred to as natural guide lines. This type of guide line is preferable to artificial ones (also referred to as tactile), except when warning of danger. We should therefore aim to integrate natural elements in the design as much as possible.

'Artificial guide lines incorporate elements within the paving that indicate direction and danger. In areas where there are no natural guide lines, such as kerbs and walls, artificial guide lines make it easier to navigate for the partially sighted. This is particularly the case in open spaces and complex transport hubs.'

People with guide dogs will be able to benefit from good design that reduces navigation barriers, and they have an added advantage in that they are guided past all obstacles by their dog (Storliløkken et al., 2012; Tennøy et al., 2013, The Norwegian Public Roads Administration and The Norwegian Building Authority, 2015).

It is particularly important for the visually impaired that they feel safe when crossing the road on *pedestrian crossings*. The blind will find the crossing by following the kerb to the end of the rounded edge with their cane. Signposts and traffic light posts are used to detect where the crossing starts, and a warning strip can be a good help if not covered by ice/snow. The visually impaired navigate across roads and pedestrian crossings by rolling their feet on the kerb before they head off at 90 degrees. If the kerb is curved or too low, this can cause a hazardous situation and will make navigation difficult.

For those who use guide dogs, the challenges are slightly different. Guide dogs are trained to find zebra crossings and to use them to cross the road. If the zebra stripes are covered by snow and ice, the dog may well be unable to find the crossing. Those who use a cane will find that a normal kerb is a better navigation aid than other options, but because dogs might walk past normal kerbs – particularly in the winter if snow clearance is poor – there is a preference for dropped kerbs among guide dog users as this allows them to detect that they are heading onto the road (Tennøy et al., 2013).

'In station areas, the blind and partially sighted face more challenges than any other group of people, mainly due to barriers associated with navigation and information.'

Navigation clues are essential for the partially sighted/blind to be able to find their way across long sections and/or in unfamiliar places as they walk **to and from bus stops and railway stations.** Blind and partially sighted people face more challenges than any other group in station areas, mainly due to barriers associated with navigation (and information). Navigation barriers in station areas and on the way to/from stations are largely associated with a lack of standard designs for guide lines, broken guide lines, inadequate contrast marking of doors, poles, etc., and illogical platform number sequences (the blind often count their way to the correct platform). This is confusing for anyone trying to find their way. Other navigation barriers include covered-up navigation clues such as shrubs that break a natural guide line along a kerb; gravel and dirt in tactile guide lines due to a lack of servicing; or obstacles placed on footways (bollards, bicycles, A-frames, etc.), on top of guide lines or in front of information screens. Good winter servicing is important to ensure that guide lines are kept clear of snow and ice, and to reduce other challenges like slippery and uneven surfaces (Aarhaug et al., 2011; Aarhaug and Elvebakk, 2012; Tennøy et al., 2013; Øksenholt et al., 2014; Krogstad and Skartland, 2016).

The *physical design of station areas* must take account of several important factors. It is essential that all steps have handrails, and that automatic outward-opening doors do not open too fast, to avoid them crashing into somebody's face if they fail to detect the door in time. Bane Nor's station handbook (Stasjonshåndboka) presents all the requirements, recommendations and guidelines for station design. Good lighting is important for those with some residual vision. Indoor lighting should never involve excessive contrast as the visually impaired can take time to adjust to changes in light. Large windows can cause a glare that makes navigation challenging for some (The Norwegian Public Roads Administration, 2014; Krogstad and Skartland, 2016).

On board public transport, real-time systems must provide audio information. If a real-time system is not available or is down, the partially sighted are completely dependent on the driver for relevant information. If a partially sighted person does not use a cane or a guide dog and does not inform the driver of their disability when boarding, it can be difficult for the driver to show due consideration and provide appropriate assistance during the journey (Aarhaug et al., 2011; Aarhaug and Elvebakk, 2012).

'Access to information before and during the journey is extremely important for the visually impaired.'

Access to information before and during the journey is extremely important for the visually impaired. This group of people will often be using special text-to-speech software. If PDF timetables are laid out incorrectly, not all software will be able to convert to speech. This increases the risk of miscommunication. It is therefore important to ensure that information is easy to access by as many people as possible through apps, journey planners, websites, enquiry phone lines, etc.

Many visually impaired people find their smartphone very useful, but to ensure that people with sight loss have access to relevant information, screens and monitors should nevertheless be mounted at the right height (not too high), font sizes must be sufficiently large, and glare must be minimised for outdoor screens. Audio information is also important for the partially sighted, but this is often not provided, or the chosen solution is unsatisfactory (poor sound quality, difficult to find the buttons). Tactile information boards in station areas can also help the partially sighted and blind to navigate, but these must be designed well and should never include too much irrelevant information. It is very important to the visually impaired that staff are on hand to provide assistance and information in station areas and on board vehicles. In many cases, this is the group that relies most heavily on driver information to make sure that they get on and off the right bus at the right stop, and it is important that the driver stops the bus at marked boarding points and informs passengers where the bus is going (Skjetne and Zachariassen , 2003; Aarhaug et al., 2011; Aarhaug and Elvebakk ,2012; Krogstad and Skartland, 2016).

'Unforeseen events are often difficult to handle for the visually impaired because they tend to memorise complete routes. This makes them particularly vulnerable when changes occur.'

Unforeseen events are often difficult to handle for the visually impaired because they tend to memorise complete routes. This makes them particularly vulnerable when changes occur. Whenever a passenger encounters a problem, it is important that the

driver and other staff provide good service. Such situations can make passengers feel they are an inconvenience, particularly if the driver is pressed for time and is too rushed to assist those who need it (Aarhaug and Elvebakk, 2012).

Good and clearly visible signposting of toilets is also important. Bold symbols should be used to ensure that the visually impaired can find their way to the correct rest room. This group finds it hard to access toilets with self-service paid entry. Toilets should therefore be left open to ensure access for all (Krogstad and Skartland, 2016).

Table 2: Examples of barriers associated with impaired vision, with suggested interventions.

BARRIERS ASSOCIATED WITH IMPAIRED VISION	INTERVENTIONS
No navigation clu	Designs should prioritise natural guide lines. Artificial guide lines for where there are no natural ones, or to warn of danger.
Obstacles on the footway	General maintenance, cut back shrubs etc. that obscure natural guidelines, remove gravel from guide lines, note the positioning of cycle racks, A-frames etc.
Ice and snow og snø	Good winter servicing
Non-standardised station designs	• Design standardisation • Logical numbering of platforms • Unbroken guide lines • Contrasting colours on doors • Handrails by steps • Automatic doors that will not open too fast • Good lighting (avoid excessive contrast, be aware that large windows can cause glare that makes it difficult to see) • Consistent use of warning and hazard strips • Marking of glass surfaces
Difficult to get on the right bus	Føreren stopper på markerte påstigningspunkter og informerer om hvilken buss det er ved synlig synshemmelse (stokk, førerhund), automatisk opprop utenfor buss (kan bidra til lydforurensning), utvikling av app eller knapp slik at synshemmede kan gi beskjed om behov for assistanse
Access to information	Driver stops at marked boarding points and informs those with visible visual impairment (white cane, guide dog) which bus it is; automatic callout outside the bus (may cause noise pollution); develop app or push-button for use by the visually impaired to notify staff of their need for assistance
Timetables that are unreadable or incompatible with technical aids	Timetables in reader friendly formats (not PDF),
Info at unforeseen events	Staff on hand
Access to toilets	Toilets that need no (self-service) payment

4. Barriers associated with hearing loss

Little research has been conducted on the travel habits of people with hearing loss and the travel barriers they meet. This group includes the deaf as well as people with partial hearing.

There are two categories of deafness: i) prelingual deafness, where the hearing loss occurs before learning speech or language and ii) post-lingual deafness, where the hearing loss develops after the acquisition of language (Espedal and Jaatun, 2002).

Some deaf people have limited speech, which makes it more difficult for them to ask for help and information. In addition to the deaf, there are many people with partial hearing. As we age, we generally lose the ability to hear high frequencies, but some will also lose the ability to hear low frequencies. While some people find that all sounds decrease evenly, others experience varying degrees of sound distortion, or they can hear sounds of a neurological nature.

In addition to an inability to hear sound at certain frequencies, many will find it difficult to differentiate between meaningful sound and background noise. Fifteen per cent of the population have partial hearing (Folkehelseinstituttet, 2004), and the proportion is clearly highest among those over 65 years of age. Almost half the population over 65, and approximately three quarters of the population over 74 have hearing loss that impacts communication.[3]

Poor sound reproduction from poor-quality loudspeakers, and hard surfaces that produce poor acoustics, can make it virtually impossible to hear what is being said. It is important to keep in mind that people who use a hearing aid will not only have sounds that they want to hear amplified, but general noise as well. When choosing equipment, the aim should therefore always be to opt for the least noisy alternative, and if possible, noisy sound sources should be strategically positioned and separated (Espedal and Jaatun, 2002). Consideration should also be given to fitting noise-absorbing materials in walls and ceilings, and to installing hearing loops and sound equalisers.

'Poor sound reproduction from poor-quality loudspeakers, and hard surfaces that produce poor acoustics, can make it virtually impossible to hear what is being said.'

Photo: Ruter AS/Nucleus/Magnus W. Sitter

Good lighting is important to ensure that people with hearing loss can read text, signs, signals and monitors, and makes it easier to lip-read (Espedal and Jaatun, 2002).

It is essential that people with hearing loss have access to good and **updated visual information** such as real-time systems on board vehicles and in the station area. Krogstad and Skartland (2016) found that many wanted a dedicated screen for reading

3 https://www.fhi.no/nettpub/hin/grupper/eldre/

important messages and/or that existing screens should make more use of the comments field to provide sufficient information. When unforeseen events occur and changes are introduced (e.g. bus replacements for trains) most information is provided over loudspeakers, which means that people with hearing loss will not hear where they are meant to go, etc. The same applies to information provided on board vehicles. Warnings like boarding signals and fire alarms should be accompanied by flashing lights, so that people with hearing loss are made aware of important events (Krogstad and Skartland, 2016,; Aarhaug et al., 2011).

Table 3: Examples of barriers associated with hearing loss, with suggested interventions.

BARRIERS ASSOCIATED WITH HEARING LOSS	INTERVENTIONS
Poor sound reproduction	Choose the least noisy sources of sound, isolate noisy sound sources, use noise absorbing materials in walls and ceilings, hearing loop system, sound equalisers
Depend on their vision for information	Good lighting
Lack of information	Visual information (e.g. fire alarm with flashing light), accessible screens, real-time systems with good visual information

5. Cognitive and psychosocial barriers

Psychological and mental health impairments can involve different forms of congenital medical conditions, or various types of temporary mental health issues that any one of us may encounter. Psychological disorders include diagnosed as well as undiagnosed conditions, that can be permanent or temporary and can present in different ways with degrees of severity.

There is little research available on the travel habits of people with disabilities, and even less on those with cognitive or psychosocial impairments (Meissonnier & Dejoux, 2016). The limited research that does exist suggests that people with mental health issues make fewer journeys than others (Mackett, 2017). It has also been demonstrated that good mobility is an important recovery factor for people with psychological disorders, while poor access to public transport leads to social isolation and a worsening of symptoms (Mental Health Action Group, 2011).

Mackett (2017) classifies psychological disorders in four groups:

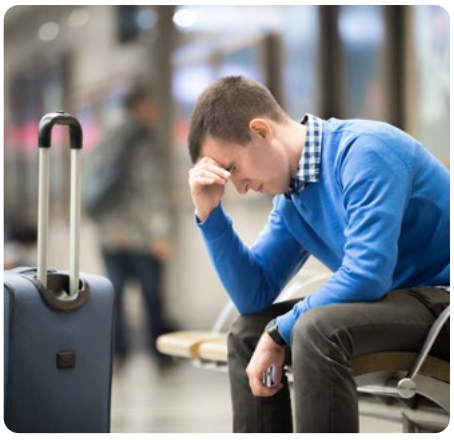
1. Disorders that affect concentration and learning (various forms of neurological disorders, dyslexia, dyscalculia)
2. Disorders that affect memory (e.g. Alzheimer's and dementia)
3. Psychological disorders (e.g. anxiety, depression and personality disorders)
4. Social and behavioural disorders (e.g. Asperger's syndrome and ADHD)

In the sections below, we have grouped disorders that affect concentration, learning and memory in one category, while psychological afflictions and social and behavioural disorders are grouped in another.

Disorders that affect learning include various forms of brain damage, dyslexia, dyscalculia, etc. Learning disabilities can include anything from linguistic processing problems, attention deficit and memory issues. Memory problems are also a feature of disorders that specifically affect memory, e.g. Alzheimer's and dementia. Psychological disorders include a wide range of diagnoses: anxiety, depression, bipolar disorder and a number of personality disorders. Behavioural disorders include Asperger's, autism and ADHD.

All information below is sourced from Penfold et al. (2008), Mental Health Action Group (2011) and Nielsen and Skollerud (2018), unless otherwise specified.

Disorders that affect concentration, learning and memory



People with disorders that affect their capacity to concentrate, learn or remember can encounter barriers that are caused by a **combination of their disorder and external factors.** People with a learning disability can experience challenges associated with the attitudes and behaviours displayed by drivers and fellow passengers, by overcrowding, route changes and timetable alterations. They can also find it difficult to understand rules and procedures (Mackett, 2017). In addition, interviewees reported that travelling is associated with emotional problems like frustration, nervousness, lack of confidence and a feeling of shame. Chandaria and O'Hara[4] have identified a number of factors that make travel difficult for people with dementia: frustration due to finding it hard to process information, poor balance and spatial understanding, perception problems

4 Reported from stage at the Community Transport Association's annual conference in 2014. https://www.busandcoachbuyer.com/cta-2014-annual-conference-england/

that make it difficult to deal with change, new journeys and problems associated with fellow passengers – dementia sufferers can easily go into fight-or-flight response mode, which makes them come across as aggressive.

People with cognitive impairments need **information and navigation systems** (guide lines, signage etc.) to be consistently designed so that they do not have to figure out how different systems work for every part of the journey. Guide lines, tonal contrasts and other interventions originally intended for the visually impaired will be useful for those with cognitive impairment as well and can make navigation simpler for them. Distractions that are not specifically associated with the journey should be kept to a minimum, so as to lessen the need to focus on several things at once. Information should be displayed in a single section, as 'rolling' text can be difficult to read for those with cognitive impairments (Krogstad and Skartland, 2016). People with dyslexia can find it difficult to read (especially block capitals), process information whilst listening, understand and process numbers, and spell words correctly when typing into journey planners and wayfinders (Lamont et al., 2013).

Psychological afflictions and social and behavioural disorders

People with psychological afflictions and behavioural disorders can encounter barriers that cannot be addressed by technical interventions. These may include cost, overcrowding, a lack of understanding from service personnel, poor access to public transport in rural areas, inadequate information when unforeseen events occur, and stigma.

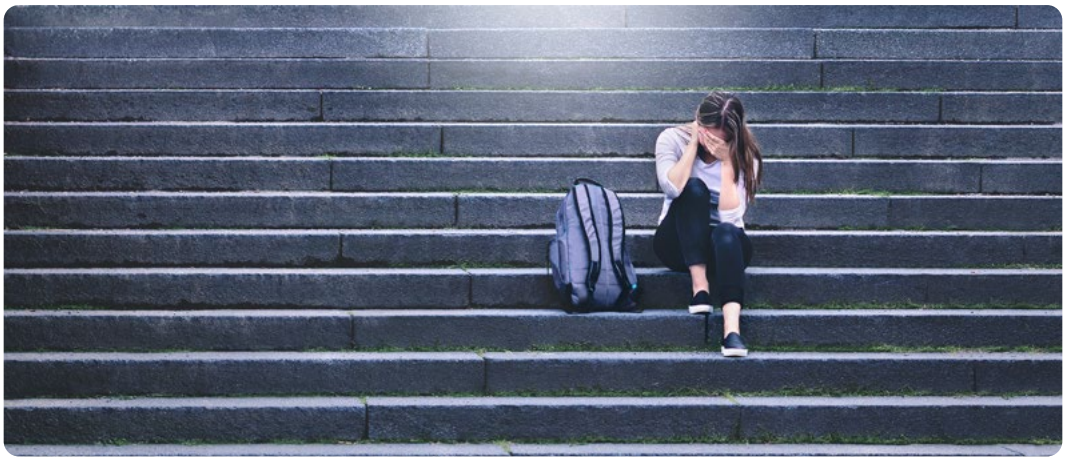
The social environment associated with the journey is very important for people with mental health impairments. The passenger's sense of safety is heavily affected by the attitudes of service personnel. Many feel ignored by staff because their disability is not visible, and there is a call for greater awareness of mental health issues among bus drivers. There are often no staff on hand to provide assistance, which can be problematic when booking tickets and using new technology. In England, passengers with psychological impairments often say they have been stigmatised by fellow passengers, but there are few similar reports in Norwegian studies.

Access to public transport will significantly affect the mobility and everyday life of people with mental health impairments. Poor access to public transport in rural areas makes everyday travel difficult for many. Anxiety can stop someone from catching the intended bus, and if the next service is a few hours away, this will have a severe impact on the passenger. In areas with infrequent services or poor coordination between different modes of transport, many will opt for alternatives like a car or bicycle. *Long waiting times caused by poor connections* can increase the sense of anxiety, and timetables should, therefore, be structured to simplify modal shifts if possible.

There should be adequate **seating** aboard vehicles and in station areas, as standing is considered an extra burden. Overcrowding on public transport means that many try to avoid travelling at peak times. Many would like seats that are screened to avoid the sense of having too many people at close quarters. Using seats reserved for pregnant women, the elderly and people with disabilities can be challenging, as most people consider these seats to be reserved for those with a 'visible need' to sit. If someone with an invisible disability takes such a seat, it can be difficult for them to decide what to do if someone with a visible disability indicates a need to sit down. On the one hand, it may be considered rude and disrespectful if the person without a visible disability does not give up their seat, while on the other hand, this person may feel 'forced' to give up their seat to someone who may well have less of a need for it. This is a problem that has no specific solution, but it may be a useful intervention to run information campaigns to highlight the fact that not all disabilities are visible.

'Solutions such as real-time systems are interventions that give a better overview of the travel situation. This greater sense of control can sooth anxieties.'

It is very important to have access to *information* that makes it possible to plan the journey and turns it into a routine, particularly for long journeys and journeys with multiple legs, as these are found to be particularly onerous.



Lack of information creates confusion and causes loss of confidence and control. Solutions such as real-time systems can ease such situations and give a better overview of the journey situation. This increased sense of control can alleviate anxieties. Real-time systems are not available in all parts of the country, and if a real-time system does not work as it should, this can cause stress. For some, various travel apps can help to reduce stress and anxiety levels. It is important that information channels are largely standardised and designed to make them easy to read. If your level of anxiety is high, it can be difficult to ascertain where there is available information at a given station or for a given mode of transport, and it can be hard to read small print. Information about a ticket's validity and duration should also be clearly visible on paper tickets as well as on their electronic counterparts.

Access to toilet facilities is a concern for people with mental disorders. A lack of toilet facilities can create problems for those who suffer from anxiety and perhaps have problems with food allergies, food intolerances or IBS (irritable bowel syndrome) – all of which can cause an urgent need to use the toilet.

Table 4: Examples of barriers associated with cognitive and psychosocial barriers, with suggested interventions.

BARRIERS	INTERVENTIONS
Overcrowding	Adequate seating, screened seating areas, information that not all disabilities are visible (seats reserved for disabled people are currently perceived to be reserved for the visibly disabled), increase the number of seats for disabled people
Lack of understanding among staff	Training of drivers and station staff
Difficult to ask for help	'Travel assistance card' to be shown to staff if required
Behavioural problems and stigma	Information campaigns on the underground/buses etc.
Poor access to public transport and long waiting times between services	Increase the number of services, increase the number of direct services, better coordination of services
Difficulties with technology (ticket purchases etc.)	Staff on hand
Processing of numbers and letters	Alternative pictograms, avoid rolling text, avoid excessive distracting information, large fonts to increase readability when stressed
Lack of information	Real-time systems, standardised information, information about ticket validity and duration
Journey changes	Staff on hand
Lack of toilet facilities	Toilets in station areas/on long bus or train journeys

6. Asthma and allergies

In Norway, 1.4 million people suffer from asthma, allergies or eczema, or a combination of all three. The numbers are increasing. Asthma is a chronic inflammation or irritation of the airways that may cause coughing fits, chest tightness, etc. An allergy is hypersensitivity to specific substances in the environment and can cause a number of symptoms: hay fever; runny nose; itchy eyes; hypersensitivity; asthmatic reactions; eczema; headache; and in a worst-case scenario: anaphylactic shock and death (Espedal and Jaatun, 2002; NAAF, 2011). In a public transport setting, potential environmental allergens are associated with: release of gases like formaldehyde on board vehicles and in station areas; the use of nickel and chrome as materials on board vehicles and in station areas; mould in station areas; pollen from trees and plants around the station area and on the station access/egress route; general air pollution from road traffic; animals or allergenic animal substances on board the vehicle; allergy to perfume and chemicals, etc. (Espedal and Jatuun, 2002).

There are guidelines to assist with **choosing materials and servicing and maintaining** built environments so as to avoid challenges caused by the release of gaseous substances, formation of mould, etc. A good indoor climate will help to reduce symptoms for people who suffer from asthma and allergy (NAAF, 2011).

Exposure to allergens may be an unavoidable barrier to using public transport. When booking flights, it is possible to reserve seats that guarantee non-exposure to animals in the cabin, and the airline and cabin staff can be forewarned about extreme food allergies (e.g. nuts). Necessary precautions can be put in place, and the cabin staff will inform the other passengers. Trains have dedicated zones for animals,[5] but this is not the case for buses, trams and metro rail. It is therefore conceivable that some people with severe animal allergies will not be travelling by these modes. People who are allergic or

5 https://www.vy.no/kundeservice/sporsmal-og-svar/sporsmal-og-svar-om-tog/bagasje-og-spesielle-behov

hypersensitive to chemicals can find it difficult to avoid being exposed to the substances they react to.

In areas around bus stations, railway stations and airports, **landscaping** can create a pleasant atmosphere. To some extent, vegetation can also serve as an air filter and as a biotope for pollinating insects. On the Oslo underground, indoor plant walls have been installed at the Nationaltheatret station to improve the air quality. Plants absorb particulates, thereby making it less stressful for asthmatics and other vulnerable groups to spend time there. However, some varieties of plants and trees can be troublesome for large sections of the population. Birch, hazel and willow in particular are varieties that many are allergic to. A 100-metre buffer zone, free of trees that are high in pollen, is recommended for places where people need to spend time, because a large proportion of the pollen from these varieties will fall within this radius (Bjerke et al., 2005).

Table 5: Examples of barriers associated with asthma and allergies, with suggested interventions.

BARRIERS	TILTAK
Animal hairs	Dedicated animal zones
Pollen from trees enroute to the stop/station stasjonsområder	Plant hypoallergenic tree varieties
Particulates	More landscaping
Gases released from materials, or allergies	Choose hypoallergenic materials with low levels of gas release
Perfumes and chemicals	Awareness campaign on public transport and for frontline staff

7. How to accommodate as many as possible

There are many similarities between the barriers encountered by different groups and the interventions proposed to assist them. Designs that are primarily intended to ease the travelling for some will, in many cases, improve the travel experience for all. This is precisely what universal design of the transport system is all about, ensuring that everyone can use the services, irrespective of their level of functionality and age. There are many specific examples. For instance, studies show that interventions like the raising of platforms, originally intended to make it easier to board for people with impaired mobility, in fact benefit all passengers (Fearnley et al., 2009; Aarhaug et al., 2009; Ruud et al., 2005). Guide lines and high tonal contrasts are other examples. These measures are often associated with design for the visually impaired, but they can also be helpful for those with cognitive impairments, for people who are unfamiliar with the location, and those who do not know the language, etc. Appropriate non-glare lighting is particularly important for those with partial vision or hearing, but good lighting is important for all of us and can make us feel safer (Meyer et al., 2019).

'Universal design is all about designing the transport system so that everyone can use the services, irrespective of their level of functionality and age.'

Footways and squares must be well built, maintained and serviced in winter. They should be logically and holistically designed with clear walking corridors and dedicated zones for street furniture and landscaping. Paving should be even and non-slip, and materials should be durable and of high quality. Excessive variation of underfoot surfaces can make it challenging to move and navigate with both wheels and canes. Furthermore, non-existent or poor winter servicing, and slippery conditions underfoot can cause problems and challenges for

all of us, but the elderly and those with impaired mobility or vision are particularly vulnerable in such circumstances. Footways should be kept clear of snow and ice, and gravel and dirt must never be allowed to cover guide lines. This puts a heavy responsibility on those who maintain these facilities. Paving must be non-slip at the very least, and people using wheels (e.g. wheelchairs, walkers, prams and buggies) should be able to move effortlessly without encountering obstacles. In places where good natural guidelines have been incorporated into the layout, these should be available throughout the winter. This can be achieved either by keeping the natural guidelines clear or by planning for temporary features (e.g. banks of snow) to be used instead. It is important, however, that these do not represent obstacles to the free movement of wheels and those who walk with difficulty.

Access to seating is important. All of us have days when we feel particularly weary, have developed a painful blister or pulled a muscle and need to sit down. The elderly and people with mobility impairments will have a greater need to sit down more often, and people with mental health impairments may need to sit down to calm their symptoms of anxiety, etc.

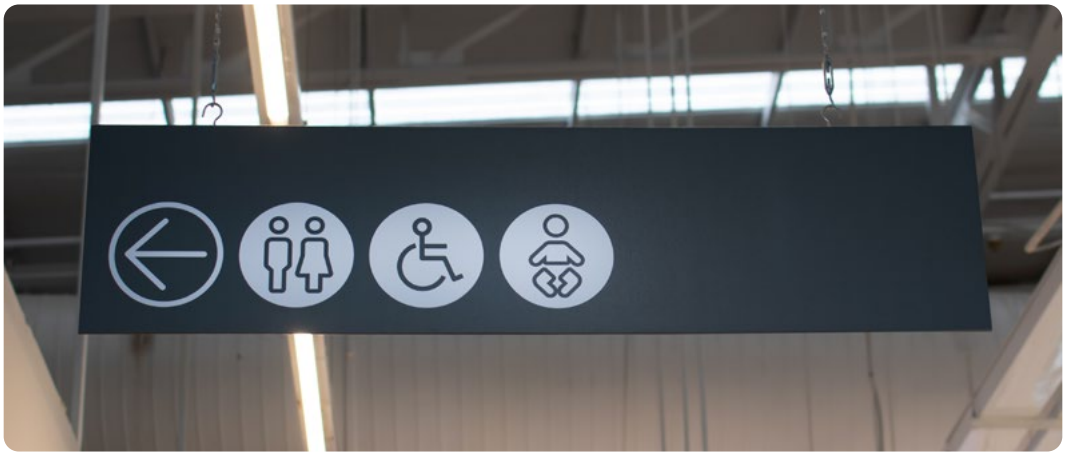
Access to seating is important along the walk to the station or stop (particularly if this involves a long distance), in waiting areas and on board vehicles. A study has found that willingness to pay increases among all passenger groups if waiting shelters with seating are provided and if there are seats available on board (Fearnley et al., 2009; Veisten et al., 2020). Overcrowding at stops/platforms and on board the vehicle can be problematic, as this can make it difficult to find a seat. Because some disabilities are invisible (anxiety, hearing loss, pain, some forms of vision and balance problems, etc.), it can be problematic that seats reserved for the elderly, pregnant women and disabled people are currently perceived to be reserved for those with a 'visible need' to sit. Whether a person wants to give up their seat for someone with a 'visible need' will always be a matter of personal discretion, but information campaigns can raise awareness that some people may be in great need of a seat – even if it is not immediately apparent.

'The willingness to pay increases among all passenger groups if waiting shelters with seating are provided and if there are seats available on board.'

Because some disabilities are invisible (anxiety, hearing loss, pain, some forms of vision and balance problems, etc.), it can be problematic that seats reserved for the elderly, pregnant women and disabled people are currently perceived to be reserved for those with a 'visible need' to sit.

Standardised information across regions and modes is an intervention that will benefit everyone. It is important that information is provided both visually and audibly, and that the sound reproduction and the readability of text is of a high standard. Information in writing should be provided in complete sections of text that are sufficiently legible for anyone to have enough time to read. Fonts must be sufficiently large to ensure universal readability and block capitals should be avoided. Children who cannot yet read, and tourists who are unfamiliar with the language can benefit greatly from alternative visual presentation, such as pictograms, as can people with cognitive impairment.

Real-time systems in station areas and on board vehicles are positive interventions that benefit all passengers. In station areas they can provide information about delays and the time of the next service. On board vehicles, screens and audio information can make orientation simpler. Blind and partially sighted people who find it difficult to read will be able to hear the name of the next stop and therefore be less dependent on the driver. People who suffer from anxiety will feel that this boosts their sense of control of the journey, and people who are unfamiliar with the location will find it easier to keep track of where they are getting off. Wheelchair users, who tend to be seated below window level on buses, or are not facing the direction of travel, will also find that this makes it simpler for them to keep track of where they are.



Toilet facilities are needed by everyone at regular intervals. To make sure that these are accessible for all, self-service paid entry systems should be discontinued (the blind and partially sighted find it really difficult to use these). Toilets must be designed in compliance with the appropriate standards and requirements to ensure that people with impaired mobility can use them. Heavily scented perfumes and chemicals in detergents and air dispensers should be avoided as far as possible within the bounds of a safe environment.

However, although there are many similarities between designs that benefit multiple groups, we also need to take account of some conflicting needs.

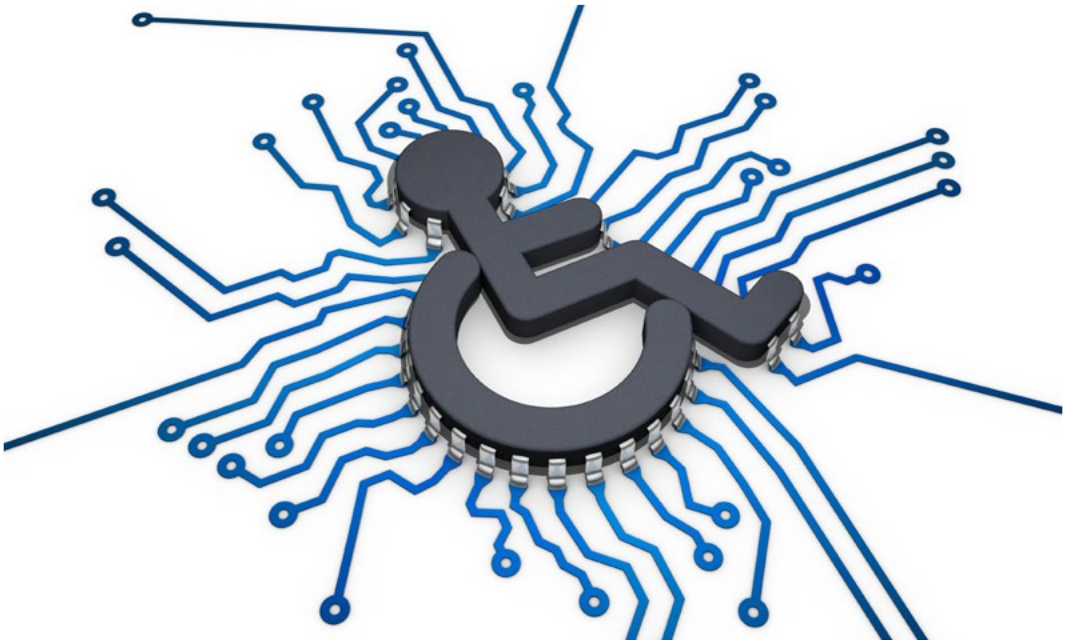
For instance, this applies in respect of the **design of paving and kerbs at pedestrian crossings.** While those with impaired mobility want as few bumps and edges as possible, people with impaired vision need such features to navigate. Those who have a guide dog will tend to prefer dropped kerbs, while those who use a white cane need a normal kerb to be able to head in the right direction across the road. To solve this problem, a compromise has been reached by agreeing a standard 2-cm kerb at pedestrian crossings. This is sufficient for the visually impaired to notice the transition between walkway and carriageway, but low enough to allow wheelchair users, prams and buggies to traverse them with ease. It is difficult to ensure that this kerb stays at 2 cm over time. Wear and tear, as well as paving deposits, and seasonal variation (i.e. leaves, winter servicing, and snow clearance) can cause the 2 cm kerb to become higher or lower, or to disappear altogether.

Correct positioning of **information screens and ticket machines** can also be challenging. Although there are statutory standards for the design and location of such machines, inspections nevertheless show widespread non-conformance (as described in the section on barriers associated with impaired mobility). Wheelchair users, people of short stature and children can find it difficult to use ticket machines if the screen or payment mechanism is too high or at the wrong angle, while people with balance issues can find it difficult to use low-level ticket machines. The partially sighted can find it difficult to see information displayed too high or too low, while wheelchair users and children may find it difficult to see information at eye level or higher – particularly if there is overcrowding or if the monitors are mounted in the wrong position or at the wrong angle. This could be solved by installing information screens and ticket machines at multiple heights.

Ee should also highlight the difficulty of balancing concerns for people with **severe dog allergies against concerns for the blind** who use guide dogs. The various operators differ in their approach to this dilemma, but those who suffer from allergies can rarely be confident of an environment completely free of allergens.

8. Concluding remarks

Universal design is about more than the design of our physical environment. The organisation of the public transport system, the social environment associated with the journey, and automated ticketing systems are all factors that can introduce barriers to using public transport for people with disabilities and for others.



How the public transport system is organised impacts its accessibility. Infrequent services make it difficult to use public transport in general. If an area has limited public transport, universal design has little impact. Several modal shifts on a single route can increase access to more parts of the town, but many will perceive multiple changes as a negative experience. If the public transport system is planned with modal shifts in mind, punctuality is imperative. These challenges will vary between geographic areas, and passengers' perceptions will be based on their individual circumstances.

'In many cases, it is very important that staff are on hand to assist passengers who need it, yet the number of staffed public transport hubs in Norway is limited and falling.'

The social environment associated with the journey involves interactions between passengers and between passengers and staff. In many cases, it is very important that staff are on hand to assist passengers who need it, yet the number of staffed public transport hubs in Norway is limited and falling. This may put some people off travelling by public transport because they are unsure whether they will receive the help they need during their journey. It is important that available staff are well informed about the needs they may encounter. People with various mental health impairments felt that staff had little understanding of mental health disorders, and there was a feeling of being an inconvenience to staff reported by those with impaired mental health, mobility and vision. To ensure that drivers can provide the level of service required, it is important that schedules are timed to allow for such service provision. One out of three bus drivers report that they currently have insufficient time to offer the level of service they would like to provide (Krogstad et al., 2019). Delays and pressures of time can also cause drivers to drive more aggressively to make up for lost time and to keep to the timetable, which in turn may cause reluctance to travel by public transport among some people.

Automated ticketing systems have reduced our reliance on personal contact with service personnel. There are advantages to this, in that accessing information is easy and there is no need to contact staff if you would rather not, which can ease the situation, e.g. for those with social anxiety. At the same time, this can cause problems for those who depend on assistance.

'The partially sighted/blind, and people with various forms of mental health impairment find it difficult to read and access information and often need extra help from other people to buy tickets or to find their way within station areas.'

People who find it difficult to read or access information – the partially sighted/blind, and people with various forms of mental health impairment (anxiety, dyslexia, dementia, etc.) – often need extra help from other people to buy tickets or to find their way within station areas. Staff who are on hand to help passengers navigate and

buy tickets can be a positive measure for many, e.g. people with impaired vision or mobility, the elderly who are unaccustomed to using modern technology, or tourists. Even if station areas and public transport vehicles meet the physical requirements for universal design, this is of little use if people choose not to travel because they feel unsafe.

Universal design is about ensuring that everyone can participate in society on equal terms. As we work to achieve an ever more universally designed public transport system, the goal is to make it simpler and easier for more people to use public transport. When people with disabilities get better access to the public transport system through universal design, this can increase their opportunity to play a part in society on par with 'everybody else'. This may help to increase involvement in various political, economic and social arenas, and to reduce the sense of isolation and exclusion. Universal design is not only a strategy to increase access to the public transport system, it is also a recognition that all human beings are different and that we all have a basic right to participate in society in the way we wish.

'When people with disabilities get better access to the public transport system through universal design, this can increase their opportunity to play a part in society on par with 'everybody else'.

We hope that reading this article will have increased your understanding of the complexities involved with universal design, and that you are now ready to get started with the work of planning, developing and implementing interventions that will take society a step closer to full universal design.

9. Further reading

Aarhaug, J. and Elvebakk B. 2012. Universell utforming virker - evaluering av tiltak i kollektivtrafikken. TØI-rapport 1235/2012. Transportøkonomisk institutt, Oslo.

This report by the Institute of Transport Economics summarises the evaluation of the funding scheme for better access to the public transport services provided by local authorities. The main finding is that measures implemented through this funding strand were favourably received, and that they help to make it easier for people with disabilities to travel by public transport. At the same time, the study demonstrates that these interventions do not solve all the problems encountered by people with disabilities when they travel.

Storliløkken, M., Martinsen, H., Tellevik, J.M. and Elmerskog, B. (2012) *Mobilitetsopplæring; mobilitetsopplæring av barn, unge og voksne med synshemming.* Tapir akademisk forlag, Trondheim

This book explains how children, young people and adults with impaired vision are trained to navigate in their surroundings. It is a good introduction to the principles of mobility for the blind and partially sighted.

Mykletun, A., Knudsen, A.K. and Mathiesen, K.S. 2009. *Psykiske lidelser i Norge: Et folkehelseperspektiv.* Rapport 2009:8, Nasjonalt folkehelseinstitutt, Oktober 2009

This is the first comprehensive report on mental disorders in Norway. It describes the prevalence of the various mental disorders in different age groups, and lists the relevant vulnerability factors, risk factors and protective factors. The report also documents the most significant consequences of mental disorders for Norwegian society, and discusses treatments from a public health perspective.

Sosial- og helsedirektoratet. 2003. *Universell utforming over alt! Planlegging og utforming av uteområder, bygninger, transport og produkter for alle.* Sosial- og helsedirektoratet, Oslo.

This is a collection of multidisciplinary articles published by the Norwegian Directorate for Health and Social Affairs. It seeks to provide a broad introduction to the discipline of universal design. The articles are intended for anyone with an interest in the planning and design of environs and products, or who specifically works in this field.

Husbanken/NAAF. 2011. *Universell utforming av bygg for personer med astma, allergy og annen overfølsomhet*. [URL] http://biblioteket.husbanken.no/arkiv/dok/Komp/Uu_bygg.pdf

These guidelines provide an overview of aspects that need special attention when planning, building and operating buildings that seek to be certified as universally designed for people with asthma and allergies or other hyper sensitivities.

Husbanken/Hageselskapet. 2009. *Veileder: Universell utforming av uteområder ved flerbolighus*. http://biblioteket.husbanken.no/arkiv/dok/3472/uu_uteomrader.pdf

These guidelines seek to inspire good planning for full inclusion and enjoyment in communal outdoor spaces for houses in multiple occupancy (HMO). Highlighted topics include access, parking, entrance areas, play and recreational areas and the green zone around communal spaces. The guidelines apply to ground-level areas and do not include private gardens.

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4

Universal design and public participation in planning processes

RANJA B. SJØSTRØM, TORUNN ÅSHEIM, RAGNI L. HELWEG,
HÉCTOR PIÑA-BARRIOS AND CHRISTINE R. NILSEN

This chapter focuses on the physical transport structures required for walking, cycling and driving. The aim is to provide input for critical reflection on planning processes, universal design and public participation, viewed from a planner's perspective and based on the authors' experiences as land use planners, architects, landscape architects and roads engineers. The article aims to deepen the understanding of the complexity inherent in this system and how this may be a barrier to achieving effective and comprehensive solutions.

'Travel is about making journeys'

Héctor Piña Barrios, architect

Graduated from Bergen School of Architecture with a Master of Architecture in 2009. He works at the intersection of building architecture, landscape architecture, urban design and planning, with a strong focus on sustainability and interdisciplinary collaboration. He has experience in feasibility studies, place-based analyses, land use strategies, process management and project management. He was affiliated with the section for land use planning and analysis in Multiconsult ASA, where he served as the regional contact for the land use planning network. He has worked as an architect and planner at 3RW Arkitekter AS, and since 2020, he has also been responsible for planning at En til En Arkitekter AS. He has experience as a teacher, examiner, diploma supervisor and acting pro-rector at Bergen School of Architecture.

Christine Ravndal Nilsen, geographer and physical planner

Bachelor in social geography from the University of Bergen (2007), Master in physical planning from NTNU (2010) and SAMPLAN (2013). She started her career in land use planning as an executive officer for private planning applications in Askøy local authority prior to studying for her master's degree. She wrote her master's thesis for the Norwegian Public Roads Administration, where she continued to work for 5 years as a land use planner and was responsible for local community and outdoor pursuits in concept selection processes and municipal sub-plans. Since 2015, she has worked at Multiconsult Norge AS. With a strong foundation in planning theory, she has a passion for urban development projects, where her focus also lies in place-based development, mobility and sustainability.

First author Ranja Blomvågnes Sjøstrøm, roads planner and master's student in inclusive architecture

Bachelor with specialisation in technical community planning, from the Bergen University College in 2012.

Fourteen years of experience from the Norwegian Public Roads Administration's engineering section in Bergen. She has been with Multiconsult Norge AS since 2016 and universal design is one of the fields she has a real passion for. Since 2008, this has enabled her to develop expertise in universal design in road projects. She works to ensure that inclusive, functional, and sustainable infrastructure solutions are planned in collaboration with other professional fields, with a focus on quality and buildability. Since 2016, she has been a guest lecturer every year, delivering lectures on universal design and aesthetics for master's students in land use and land ownership, and for civil engineering students at the Western Norway University of Applied Sciences.

Torunn Åsheim, civil architect and land use planner

Graduated from Bergen School of Architecture in 1993 and the University of Bergen. She has experience as an executive officer and project manager in land use planning at Askøy, Flora and Bergen local authorities. For 7 years, she engaged in planning large residential and city centre areas as a project manager and planning manager in the local authority-owned company Bergen tomteselskap, where she was a driving force for ensuring that quality was a selection criterion in land sales processes. For 10 years, she has been employed as a land use planner at the consulting firm Multiconsult ASA, primarily working on master plans and feasibility studies with a focus on place-based development, mobility and sustainability.

Ragni Lucie Helweg, landscape architect

Graduated as a landscape architect from Bergen School of Architecture in 2005, with a master's in architecture, specialising in landscape. She has several years of experience with a wide range of practical skills and various academic disciplines. She is creative and solution-oriented, and is interested in a diverse range of concepts. These include historical background and sense of place, age diversity and children's presence and participation in public spaces, individual belonging in our communal outdoor spaces and appealing design. She has a strong commitment to universal accessibility and an inclusive landscape for diverse participation.

1. Introduction

One of the key principles of the UN Sustainable Development Goals (SDGs) is 'Leave no one behind'. The most vulnerable people in society must therefore be prioritised (FN-sambandet, 2019). The SDGs thus provide a good starting point for social planning. Participatory involvement within the field of transport can result in good universal design solutions in transport and infrastructure projects and foster forward-thinking development.

Figure 1 – UN Sustainable Development Goals (FN-sambandet, 2019)

The 17 SDGs. Goals 9, 10, 11 and 17 are particularly important for public participation and universal design.

1. No poverty
2. Zero hunger
3. Good health and well-being
4. Quality education
5. Gender equality
6. Clean water and sanitation
7. Affordable and clean energy
8. Decent work and economic growth
9. Industry, innovation and infrastructure
10. Reduced inequalities
11. Sustainable cities and communities
12. Responsible consumption and production
13. Climate action
14. Life below water
15. Life on land
16. Peace, justice and strong institutions
17. Partnerships for the goals

In this article, the concept of 'travel' includes all journeys that take place when walking, strolling, running, cycling, scootering, rolling, or using modes of transport such as a bicycle, bus, car, train, boat or aeroplane. The article focuses on the physical transport structures that are needed to walk, cycle or drive. Central, local and regional government, as well as private entities all develop transport infrastructure in Norway. In the local authorities, private planning proposals constitute the majority of zoning applications, and there is a dedicated guide for the planning process and private zoning plans (Norsk Kommunalteknisk Forening, 2013).

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The aim of this article is to provide input to critical reflection on planning processes, universal design and public participation, viewed from a planner's perspective and based on the authors' experiences as land use planners, architects, landscape architects and road engineers. The article aims to deepen the understanding of the complexity inherent in this system and how this may be a barrier to achieving effective and comprehensive solutions.

Photo: Ruter As / Nucleus AS/Daniel Jacobsen

The article first briefly describes the planning process for transport projects, as well as the requirements that apply to universal design. The article does not provide an exhaustive description of the implementation of planning processes under the Planning and Building Act, as this is available elsewhere. Furthermore, the article sheds light on the topic of public participation in planning processes, different levels of participation and the challenges associated with this, with a particular focus on transport projects. The authors then give their recommendations on how a planning process for such projects should be conducted in order to ensure optimum public participation and implementation of universal design. In conclusion, the article highlights challenges related to achieving effective universal design solutions and suggests ways to address these.

2. Zoning plan process for transport projects under the Planning and Building Act

The investigation and planning of road and transport projects takes place at different levels. Figure 2 below describes the relationship between the different phases of a road project and the policy documents associated with them – from concept selection processes via overarching municipal sub-plans with impact assessments, to more detailed zoning plans. Clear overarching plans are an important prerequisite for, and form the basis for, further development of area or detailed zoning plans, which in turn provide opportunities for development.

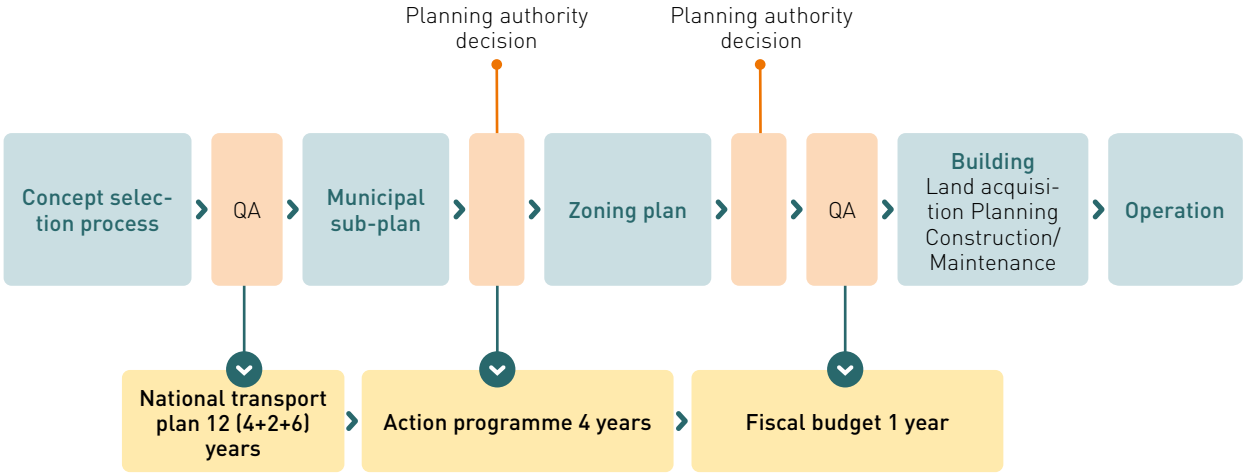

Figure 2 – The relationship between the phases of a road project and the policy documents (Statens vegvesen, 2019a)

Various types of data are collected, and analyses are performed at all planning levels, but in this context, emphasis is placed on impact assessments in municipal sub-planning processes as a basis for further planning work. The impact analysis shows, inter alia, how different road alignment alternatives could affect the surrounding environment. Under the topic of outdoor pursuits/urban and rural life, an assessment is made of the implications for the general public's ability to engage in outdoor activities that promote good health and well-being in the local community and in nature in general. Accessibility and potential barriers within the scope of the planning need to be mapped. As with other development projects, transport projects must comply with the Planning and Building Act, which regulates the possibilities and provides a framework for all developments, including public participation processes and universal design.

In planning processes under the Planning and Building Act, emphasis is placed on transparency and equal opportunities for all affected parties to participate in the process in order to produce the best possible plans. Public participation as a general principle and the principle of universal design are both anchored in Section 1-1 of the Act, the objects clause:

- The Act shall promote sustainable development in the best interests of individuals, society and future generations.
- Planning and administrative decisions shall ensure transparency, predictability and public participation for all affected interests and authorities. There shall be emphasis on long-term solutions, and environmental and social impacts shall be described.
- The principle of design for universal accessibility shall be considered in planning and in requirements relating to individual building projects. The same applies to due regard for the environment in which children and youth grow up and the aesthetic design of project surroundings.

(Planing and Building Act, 2008)

Dialogue and public participation with affected parties are anchored in the legislation and crucial for the successful implementation of good planning processes. Public participation is elaborated on in Section 3 of this chapter, where Section 5-1 of the Planning and Building Act is also discussed in more detail. This clause emphasises that local authorities have a special responsibility to ensure active participation by groups that require special adaptations. Active participation goes beyond the minimum requirement for *notice of commencement* and *announcement of the planning process*, and *presentation for public scrutiny*. The authors believe that active participation entails inviting the parties concerned to participate and to take part in a dialogue. Efforts should be made to facilitate participation by children and young people, as well as groups and stakeholders who are unable to engage directly.

'Local authorities have a special responsibility to ensure active participation by groups that require special adaptations.'

A large road development project goes through many planning phases, as illustrated in Figure 2 below. The plans become more detailed and closer to finalisation the further you progress in the planning process. A zoning plan may be the third phase and it is always the final phase in the planning of a major road development. This chapter does not cover the last two phases of a road project: the construction and operation of the site. The road owner draws up a proposal for a zoning plan either internally or through the use of a consultancy firm. Finally, the politicians in the municipality concerned consider whether to adopt the plan.

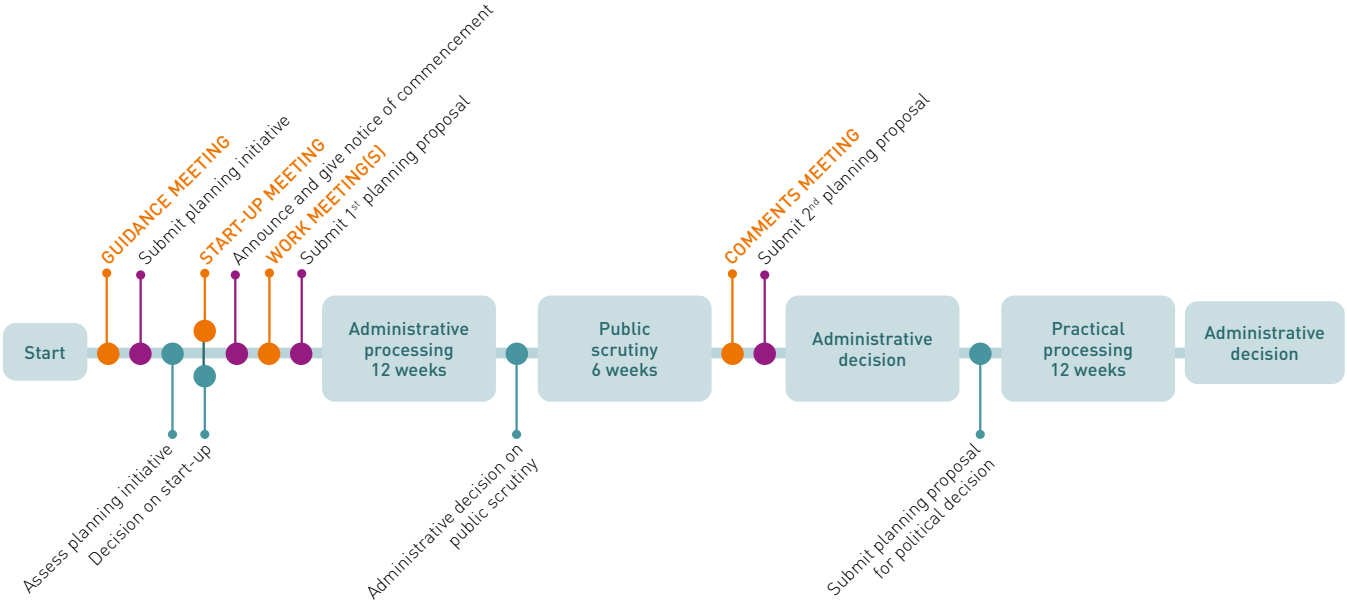

Figure 3 – Detailed presentation of a planning process (Bergen kommune, 2019)

Before permission can be granted for major building and civil engineering works, an approved zoning plan must be in place. The zoning plan consists of a plan map with associated planning provisions and a plan description.

There are two types of zoning plans: area zoning and detailed zoning

There are two types of zoning plans: area zoning and detailed zoning. A zoning plan for a road development project is usually a detailed zoning plan that focuses on the siting of the road in relation to the surrounding area. How much land does the future road require, and how do we envisage using the land adjacent to the road? The plan should include the design of the road, including junctions, pavements and pedestrianised streets, footpaths and cycle paths, crossings for soft road users, bridges (overpasses/underpasses), public transport stops and/or public transport hubs, and access to individual properties, buildings and facilities. It should also include parking, green spaces, noise reduction measures, environmental measures, wildlife measures, and any other measures on or along local roads, areas for construction waste and equipment, as well as principles for water run-off. A detailed diagram of the steps in the planning process can be found on, for example, Bergen local authority's website. This describes the various meetings that take place between the party making the proposal and the planning and building authority (guidance meeting, start-up meeting, work meeting(s) and comments meeting). It also outlines the responsibilities of the party making the proposal (submitting the planning initiative, announcing and giving notice of commencement, submitting the first planning proposal and submitting the second planning proposal). Lastly, it details the responsibilities of the planning and building authority (assessment of the planning initiative, decision on start-up, decision on public scrutiny and submission of proposal for political decision).

2.1 REQUIREMENT for universal design in transport projects

As discussed, the Planning and Building Act sets out the overarching requirement for universal design in transport projects. In the Regulations on technical requirements for construction works (TEK 17), Chapter 8 *Developed outside areas* and Chapter 12 *Layouts of and building elements in construction works* also set requirements for universal design of outside amenity areas, pedestrian access and walking lines, parking spaces, other standing spaces and vehicular access ways, stairs, siting of construction works, lifts in construction works, entrances, safety, toilets, waste systems, balustrades and ramps etc. (Byggteknisk forskrift, 2017).

In the authors' experience, the degree of compliance with the TEK 17 regulations differs across transport projects, and there may be a need to increase competence in this area. Below are some examples of requirements stipulated in TEK 17:

- Differences in level in outside developed areas shall be marked with visual and tactile means (Section 8-3 b)
- Columns, balustrades and similar shall visually contrast with their surroundings (Section 8-3 c)
- There shall be room for a wheelchair where seating is constructed (Section 8-3 d)
- Key walking lines that cross open areas in larger squares and squares subject to universal design requirements must have clearly demarcated walking zones or guidelines. Surface patterns shall not convey misleading directional information (Section 8-4 (2)).

Universal design is also one of the objectives in the National Transport Plan (NTP). The current plan is an overarching and long-term prioritisation plan for government investment in transport infrastructure projects in Norway. Each NTP covers a 12-year period and is revised every four years. In the period 2018–2029, one of the goals was to contribute to continuous, universally designed journey chains. A journey chain includes all stages of the journey, from when travel planning begins until the passenger has arrived at their destination.

To achieve this, universal design must be incorporated into all plans for upgrading and building new road infrastructure. The public road network is planned and constructed in accordance with the road standards. Some local authorities have their own road standards, but the Norwegian Public Roads Administration's standards are also often applied to municipal and private roads. Quality and design requirements are established through the agency's manuals and guides (the most relevant ones being Manual N100 Road and street design, Manual V122 Bicycles, Manual V123 Public transport, Manual V127 Crossings for pedestrians, Manual V129 Universal design of roads and streets, Manual R610 Standard for the operation and maintenance of national roads, and Manual V720 Traffic safety audits and inspections (Statens vegvesen, 2019, 15 October)).

'Infrastructure built by the Norwegian Public Roads Administration must be universally designed in order to ensure that everyone can travel.'

The Norwegian Public Roads Administration's web pages about universal design state that 'Infrastructure built by the Norwegian Public Roads Administration must be universally designed in order to ensure that everyone can travel. This means that the transport system must have good-quality solutions that enable all individuals, regardless of functional ability, to travel. Step-free access, guidance path surfaces, clear information and obstacle-free footways are key elements of a universally accessible transport system .' (Statens vegvesen, 2019, 13 November).

There are also government guidelines for universal design in action plans. The government's action plan for universal design 2015-2019 provides guidance on how to implement universal design in new areas such as ICT and welfare technology, as well as how efforts should continue in key areas such as transport, buildings and outdoor spaces.

A standard is a common framework for how something should be designed or executed, and standardisation is the process from identifying a need/idea to producing the finalised standard (Standard Online AS, 2019).

Another type of guideline used in Norway is standards. A standard is not a government directive and is not legally binding. A standard is a common framework for how something should be designed or executed, and standardisation is the process from identifying a need/idea to producing the finalised standard (Standard Online AS, 2019). Standards are developed in a collaboration between experts in the relevant field, government authorities and stakeholder organisations, and is thus the result of interdisciplinary cooperation and participation. It is important to note that 'the Regulations on technical requirements for construction works include minimum design requirements. Standards set requirements that are more detailed and include recommendations from a committee consisting of user organisations and all segments of the construction, civil engineering and property sectors' (Standard Online AS, 2018).

It can be useful for planners to be familiar with the following standards:

- **NS 11005:2011** *Universal design of developed outdoor areas – Requirements and recommendations*
- **NS 11001-1:2018** *Universal design of construction works – Part 1: For the general public and work buildings*
- **NS 11031:2017** *Universal design – Requirements for the design of buses*
- *Universal design of construction works – Wayfinding, P-750.*

Universal design is strongly rooted in laws, regulations, action plans and standards. The requirements set are intended to ensure predictable and universally inclusive solutions. The diffusion of these requirements makes it challenging for planners to have full control over which requirements apply where. For instance, the requirements in TEK 17 are not implemented in all the Norwegian Public Roads Administration's manuals. Universell Utforming AS has developed a guide that makes it easier to identify the right requirements (Universell Utforming AS, 2019).

2.2 How can universal design be better incorporated into the planning process?

Understanding who you are planning for

Knowledge is a prerequisite for competence. If universal design and accessibility in the built environment is to be improved, knowledge of user needs is crucial to deepening the understanding of the challenges users face in their daily life. This means that it is not only necessary to be familiar with the Planning and Building Act, TEK 17, manuals and other technical standards, but much more nuanced knowledge is needed of disabilities/abilities.

'Professionals must also have an understanding of the background to user needs in terms of disabilities.'

Professionals must also have an understanding of the background to user needs in terms of disabilities. In order to ensure a nuanced, qualitative and innovative interpretation and application of the regulations, it is crucial to grasp the underlying intention of the requirements. Where there is little understanding of the background for a target requirement, it will be difficult to apply it correctly and to form a sufficiently broad perspective to find a good solution. This is particularly important in the case of conflicting requirements where compromises or priorities need to be made. User needs form the basis of the target requirements.

As a planner, being able to understand and empathise with users is essential for identifying the diverse range of users, which in turn is necessary for finding clever design solutions for public facilities. Impaired sensory perception and cognitive abilities can hinder orientation and mobility, making the user feel less safe. This underlines the importance of incorporating such considerations into the design of outdoor spaces. Impairments in functional ability can be either chronic or temporary, and people can experience them for different lengths of time.

A normal life involves countless phases and situations where functional ability is reduced, as seen in Figure 4, which illustrates the wide diversity of people in society. Childhood and adolescence, pregnancy, menopause, old age, chronic, short-term or long-term illnesses, challenging life circumstances and other difficulties can impair various senses and abilities, limiting a person's capacity to understand, find their bearings in and navigate our shared outdoor spaces. We can all relate to the problems associated with being a stranger in a new place and the challenges entailed in finding our way around. The clarity, coherence and predictability of the design of roads, streets, squares, pavements, footways, signage etc. will all impact on this.

'We can all relate to the problems associated with being a stranger in a new place and the challenges entailed in finding our way around.'

Disability can restrict people's opportunities for social participation and can manifest itself in their interaction with the world around them. Many people face discrimination and are denied the opportunity to use public outdoor spaces and public services. This can, for example, apply to public transport as a result of the absence of accessible bus stops, railway stations or vehicles.

Figure 4 – Illustration 'We are all different' by Trond Bredesen

Different needs require different solutions. What works well for some may not be helpful to others. One example is the need for physical cues for people with visual impairments. A height difference of at least 2 cm serves as an important tactile indication of the end and beginning of pedestrian crossings. However, wheelchair users and people with poor balance and mobility need as few obstacles as possible in their path and prefer completely level transitions. A solution based on one group's needs may represent an obstacle to another group. Physical planning and adaptation are typically conducted by architects, landscape architects, engineers, geographers, land use planners etc. Despite good intentions, and even though planners are often knowledgeable about people living with various disabilities, addressing all variations of these can be a challenge.

In order to develop best practice for addressing these challenges, it is essential for planners to learn about the different user needs. A balance needs to be struck between individual and general adaptations. This involves treating people as similarly as possible while also accommodating unique needs where this is required, with the aim of upholding the principles of equality and inclusivity. (Lid, 2013). The best way to do this is to adopt an interdisciplinary approach. In addition to planning experts such as architects, landscape architects, engineers, social geographers, social anthropologists etc., professionals from the health and social care sector, such as occupational therapists, physiotherapists, social educators, nurses, public health workers and rehabilitation personnel can also contribute specialist knowledge to improve accessibility in society.

Last but not least, it is crucial to listen to the real experts on this topic: the users themselves. They are familiar with the specific situation and possess precise knowledge about the challenges that planners need to find solutions for. Relevant representatives from user organisations and councils for people with disabilities should be invited to take part in the dialogue. Discussions should be held verbally and linked to visual elements that foster good communication. They should also be as specific and solution-oriented as possible. Section 3 of this chapter delves further into the topic of public participation.

Universal design as a process

As described in Section 2.1, the rules and framework for safeguarding universal design are extensive. Nevertheless, many transport projects have an insufficient focus on the goal of universal design, which is to create an inclusive society with room for everyone.

'Many transport projects have an insufficient focus on the goal of universal design, which is to create an inclusive society with room for everyone.'

The authors wonder whether some planners' tendency to only conform to the minimum requirements might stem from the fact that universal design is guided by legislation, regulations, guidelines, action plans and manuals from government ministries and directorates. What this means in practice is that the regulations are often used as 'recipes' that must be followed to the letter, without any critical assessment of whether the goal of including as many people as possible is being achieved. Unfortunately, in such cases, the regulations are not used as the valuable tool they are for achieving a high level of inclusivity and quality.

We must ensure that universal design does not merely become a minimum standard or is reduced to being solely about the technical solutions.

We must ensure that universal design does not merely become a minimum standard or is reduced to being solely about the technical solutions. It is the different places and their local qualities that, along with specific user needs, must determine how guidelines and manuals are used. When a planner initiates a new project, new and unique situations typically arise, and these need to be addressed in harmony with the surroundings. Sometimes, only a small adjustment may be needed to accommodate as many people as possible, while other times, more significant modifications are required.

For example, the Norwegian Public Roads Administration's road standard N100 Road and street design provides guidelines for overarching principles that encompass traffic safety, the environment, the climate, universal design, accessibility, coordinated land use and transport planning, and architecture. The section on traffic safety states the following:

'Norway has a vision (vision zero) of a transport system with zero accidents resulting in fatalities or serious injuries.' (Statens vegvesen, 2019b)

The zero vision is a fundamental and obligatory principle in the design of streets and roads. It is a crucial and well-founded vision. In practice, however, it is sometimes thought to constitute a rigid enforcement of normative standards, with the argument that any non-conformance will compromise traffic safety. In some cases, this is a barrier to producing innovative, customised solutions that are well-adapted to the relevant site. The authors of the article believe that the ambition should be to both adhere to the manuals and the regulations and to have solutions that are sufficiently tailored and specific to their location.

At an overarching level, much of the legal and political framework in Norway is already in place. Going forward, the focus must therefore be on the implications of this for our work. Planners must learn from existing solutions and conduct evaluations of planning interventions, the siting of services and amenities and how these interconnect, the design of streets, urban spaces, transport hubs (including

ferry terminals), public transport stops, pedestrian and cycling routes, as well as regulations, guidelines, manuals and guides. What works and what doesn't? And not least from an ethical perspective – for whom does it work/not work? Dilemmas are inevitable (Lid, 2014).

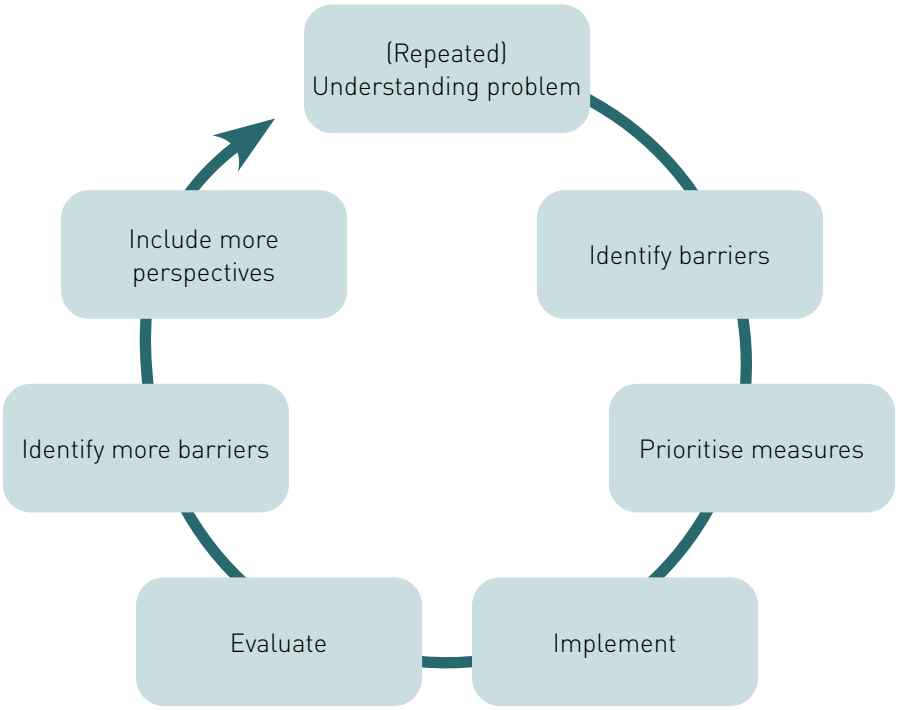

Figure 5 – The universal design process (Lid, 2013 p. 21)

A good method for ensuring that universal design is an integral part of zoning plans is to adopt a clearer approach to the design process (see Figure 5). According to Inger Marie Lid, this process can be described in eight cyclical steps. It starts with problem understanding, followed by identifying barriers and ways to eliminate them.

Measures may need to be prioritised before being selected and implemented. It is important to evaluate how specific solutions work for different groups. This can be done through systematic testing of the chosen solutions. What works and what doesn't? During the evaluation, new barriers may be identified, and it may be necessary to include additional or new perspectives, thus developing an enhanced understanding of the problem as the process progresses.

Evaluation is a keyword. It may well be that the checklist has been completed, but there will always be dilemmas that make it difficult to get everything right. Prioritising between different user groups is a recurring challenge. In such cases, it is important to have a strong knowledge base and to ask questions about the usability of the measure. The solution should always be to select measures that address the most needs. A relevant tool that can be used to evaluate zoning plans in terms of universal design is two reports that provide guidance on how to safeguard and develop universal design in transport facilities (Vista Utredning AS/Universell Utforming AS, 2019a; 2019b). Through active use of this tool, the universal design aspect of the planning work will continually evolve.

3. Public participation

The provisions for public participation in planning are set out in Section 5-1 of the Norwegian Planning and Building Act:

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'Anyone who presents a planning proposal shall facilitate public participation. The municipality shall make sure that this requirement is met in planning processes carried out by other public bodies or private bodies.'

'The municipality has a special responsibility for ensuring the active participation of groups who require special facilitation, including children and youth. Groups and interests who are not capable of participating directly shall be ensured good opportunities of participating in another way.'

Under the Planning and Building Act, public participation rules give individuals and organisations a right to take part in and to influence public investigation and decision-making processes. This means that the population of a society contributes to the planning of their own future (Kommunal- og moderniseringsdepartementet, 2014, p. 8).

Public participation is important because it is a basic premise of local democracy and gives the population an opportunity to play an active part in planning and decision-making processes. This serves to safeguard our shared values and basic living conditions in a sustainable society. Facilitating public participation is therefore vital to securing a well-working and effective planning process (Kommunal- og moderniseringsdepartementet, 2014)..

Public participation has two main functions: everyone who will be affected by the plan (directly or indirectly), must be given an opportunity to provide input to improve the plan. Additionally, important knowledge must be obtained from residents and others who are familiar with the area.

Public participation has two main functions. First, everyone who will be affected by the plan (directly or indirectly) must be given an opportunity to provide input to improve the plan. Second, important knowledge must be obtained from residents and others who are familiar with the area. Affected parties may include: registered land owners, tenants and lease holders, neighbours and other stakeholders (local community associations and third-sector organisations like the Norwegian Federation of Organisations of Disabled People, the Norwegian Association of Disabled, the Norwegian Association of the Blind, the Norwegian Association for the Hard of Hearing, the Norwegian Society for the Conservation of Nature, the Norwegian Cyclists' Association, the Norwegian Trekking Association, the Norwegian Sports Council, the various local councils for persons with disabilities, senior citizens, and young people).

Public participation is also about a transfer of empirical knowledge. Developers and planners will never be in possession of all the facts about local circumstances. It is therefore important that those who will be affected by a transport project provide their input. Few planners know how it feels to be affected by an impairment, or to live life with a disability. In our experience, plans are often improved if the affected parties take an active part in the planning process. This input may refer to anything of importance to the design of transport developments, such as road alignments and the location of picnic sites, bus stops, local access routes and parking facilities, urban squares, meeting places, footways and cycle paths, noise reduction measures, crossing points, and access to public offices.

3.1 Different levels of public participation

Different kinds of public participation are needed depending on the project's overall objective. The government's guide on public participation in planning processes refers to *circles of influence* to describe the range of participation initiatives that gives influence in planning:

The smallest circle (1) *shows facilitation of information, which can be made available without other subsequent facilitation measures than the announcement of the planning process, for instance through a notification that a planning process will commence and by making the documents available for public viewing. These two measures will satisfy the minimum requirement for public participation under the Planning and Building Act.*

Circle (2) *illustrates collection of information. It includes an open process and greater opportunity to participate by contributing to the collection of knowledge and providing a broader basis for decision-making. This could include the framework set by overarching plans for the project, place analysis, and whether there are previous public participation processes = that can inform the current project.*

The next circle (3) *shows a variety of communicative and engaging dialogue-based public participation methods that increase the opportunity to influence. For example, this could involve information meetings, workshops, open office days, Kids' Tracks, or the use of visualisation tools. In the authors' opinion, this is where active participation happens.*

Circle (4) *shows situations where the level of influence is at its strongest – achieved through cooperation and close interaction with other affected parties, for example through various local councils. In accordance with the need to balance the principles explained in Chapter 3 of the Guide, a broad planning process will normally move between the circles.*

A more detailed description of methods and good examples of participation are provided in the appendix to the government's guide 'Public Participation in Planning': *'Overview of methods'* (Kommunal- og moderniseringsdepartementet

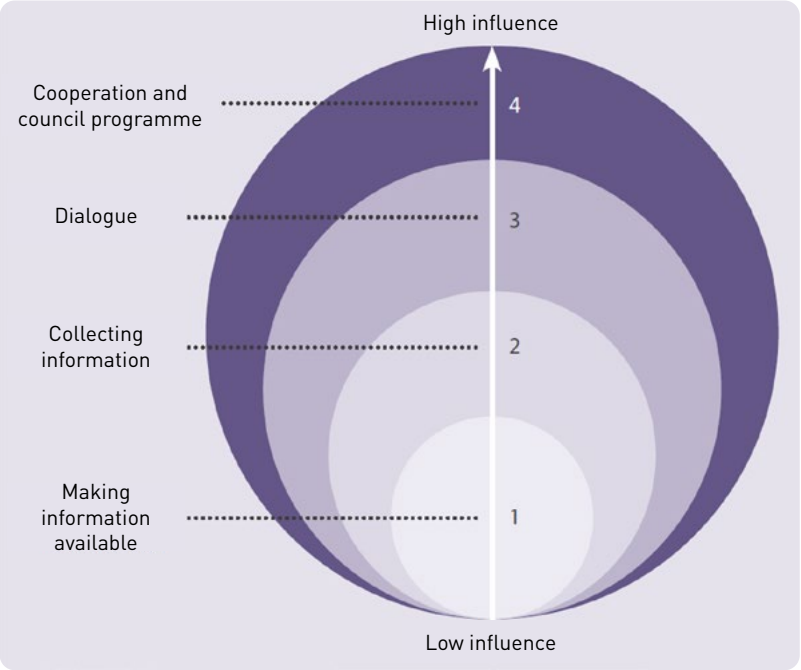


Figure 6 – The circles of influence (Kommunal- og moderniseringsdepartementet, 2014, p. 23).

The illustration shows that different planning methods provide different opportunities for involvement and influence in the planning process.

3.2 Challenges to effective public participation in transport planning

If the legislation calls for public participation and good guidance is available, then why is it so difficult to achieve? And why is it so rarely appreciated that public participation has a genuine impact on the end product? There may be several reasons, and some of them are discussed in this chapter.

Time

There is often a great deal of enthusiasm at the beginning of a project. Over time, the progress plan catches up with the process and it becomes difficult to follow up on public participation initiatives. Figure 7 below illustrates how opportunities to influence, and costs, relate to the various planning phases, from the municipal sub-plan to the zoning plan and through to construction and operation. The figure shows us that the opportunity to influence projects is greatest early in the process. The earlier the input from affected stakeholders, the greater their prospect of influence. Closer to the construction phase, the prospect of exerting influence is much smaller. At that point, solutions have already been chosen, and any changes may give rise to significant cost increases. At the early stage of the planning process, costs are lower and the details have yet to be determined. According to the graphs, there are no major cost increases involved with changes proposed in the earliest planning phases.

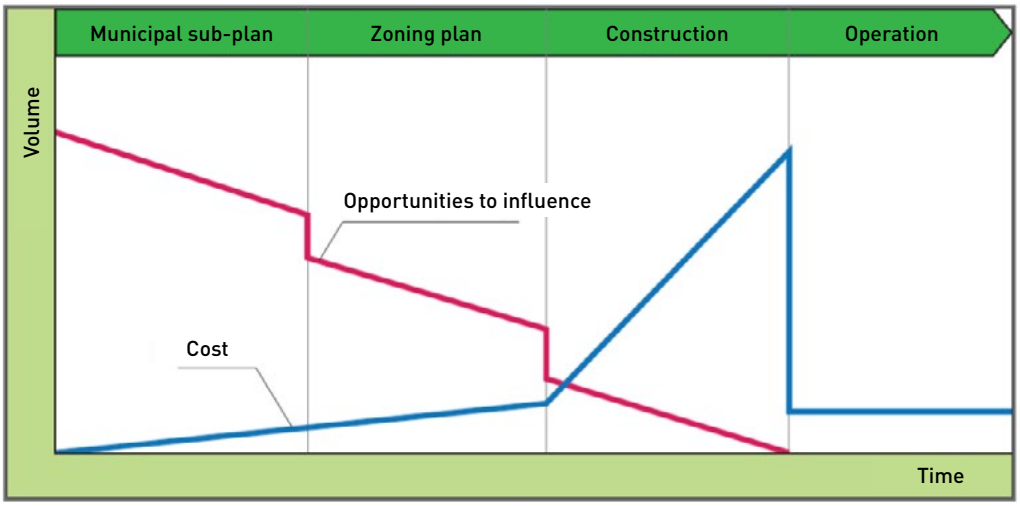


Figure 7 – Opportunities to influence, and costs, set against time (Multiconsult Norge AS).

Public participation takes time. Conducting public participation, and implementing such input in the end result, is a time-consuming process. Short deadlines are not uncommon in transport projects; submissions must be made in time to be scheduled for political debate, or to secure funding. Meetings and conversations that are conducted in writing, particularly with non-professional contributors, are perceived as hurdles that delay the process. However, in terms of total time spent and the overall finances of the project, it will normally be beneficial to spend a little extra time on public participation at an early stage in the process.

The councils that represent people with disabilities possess important expertise, and there should be more of an onus on planners to be tapping into this, where appropriate. It is however important to keep in mind that familiarity with current legislation and requirements is a responsibility that rests with the planners. As

representatives of their respective organisations, individual councillors will draw on their own experience and that of others, but their levels of expertise and experience will differ.

Another challenge is that inadequate and poorly coordinated public participation can lead to unexpected objections and protests based on misunderstandings. It can be challenging to incorporate important input at a later stage in the process, when the solutions have started to take shape. This can prolong the planning process, and the final outcomes may be less than satisfactory for the various stakeholders. Ultimately, this can undermine the public's trust in the planning tools, the process and the stakeholders involved.

Budgetary constraints

Budgetary constraints are often cited as the reason why public participation processes are kept to a minimum, even though it pays in the long run to invest more time at the beginning, as shown in Figure 7. In the authors' experience, the available budget is sadly a frequent constraint when developers chose which public participation process to implement. Compliance with the minimum requirement under the Planning and Building Act often ends up as the favoured option. The measures that are chosen may well save money in the short term, but it would have been possible to arrive at much better solutions that would have saved more money in the longer term. For this to happen, funds must be set aside in the planning process to prepare for and hold public meetings, organise open office days or conduct meetings with special interest groups. Time and human resources must also be assigned to the important task of summarising and discussing public participation input.

In many transport projects, public participation gives rise to expectations that measures will be implemented beyond the immediate scope of the carriageway or route alignment project, such as footways and cycle paths, squares, or shortcuts to bus and tram stops. Also, stakeholders often tend to hope for a higher quality in the development than what the developer had originally planned for, e.g. natural stone paving slabs rather than tarmac, better lighting or landscaping. Because the money assigned to the development is primarily earmarked for road purposes, qualities beyond the purely technical are often discarded. Users may therefore end up not using developments that are both safe and technically sound if they are felt to be unwelcoming and uninviting. On other occasions the intentions are good. The plans incorporate qualities that welcome people and make users feel safe, such as meeting places with benches and landscaping, good lighting, opportunities to rest along footways and cycle paths and the use of aesthetically pleasing materials.

Closer to the construction phase, the project may have overrun its budget, and as a result, costs must be cut. More often than not, it will be the qualitative measures that are sacrificed. Public participation outcomes may be discarded, and people may feel cheated.

Opportunities to influence

Transport projects involve many people, some of them developers, some professionals, others 'just' regular citizens. Different stakeholders exert different types of power and influence. This can affect their ability to express their views, both in terms of making their opinions understood and not least in terms of substantiating them with authority.

Figure 7 shows that the opportunity to influence is greatest in the early stages of a transport project. Such projects often focus solely on planning for roads, and the initial emphasis is on engineering issues. The road engineers' plans may well be quite advanced by the time public participation starts, perhaps not until the consultation phase of the zoning plan. Most people tend not to have the competence required to challenge the technical specifications that road engineers base their arguments on. When public participation is introduced at the very end of the process, it can be difficult to take account of important considerations and rectify any non-conformances identified. By that point, the project has advanced too far to go back and make changes without incurring major costs or suffering other consequential impacts.

Conflicting interests

Local engagement in planning is welcomed, but it can be challenging to deal with many different opinions about content and design. For example, there may be a conflict between the development and soil protection objectives, or between the universal design needs of different interest groups. Measures that are intended to ease access for wheelchair users, like gentle gradients on access routes to bus stops, can be challenging for people with balance problems. For them, access is simpler if there are steps with handrails on both sides. Audio announcements of upcoming bus stops is perceived as unnecessary noise by some passengers. However, for the visually impaired who travel by bus on their own, it is an essential measure that gives them equal access to public transport services. There will always be conflicting interests between different user groups. It is therefore important to listen to everybody's views, and to prioritise the weightiest points made. It is also important to give reasons for decisions, so that the parties properly understand the choices made.

4. Recommendations for zoning plan processes that focus on universal design and engaged public participation

This article sheds light on the complexities and challenges associated with implementing effective public participation processes in transport projects, with the aim of improving access and user-friendliness. According to the government's guide 'Public Participation in Planning' (Kommunal- og moderniseringsdepartementet, 2014), 'there is not one separate method which is "the best one" in all planning contexts'. This is because it depends on the context of the process. The type of plan and its purpose, the planning phase, and the stakeholders and interest groups involved will all be important factors. Changes that arise during the planning process may also trigger a need to adapt the chosen methodology.

Nevertheless, the authors wish to provide some recommendations for how to implement a zoning plan process:

The leader of the planning process must establish a shared understanding of the objectives and facilitate effective collaboration

The objective for the planning process must be defined as early as possible. The project will have a firm foundation if procedures are put in place to secure effective collaboration with the relevant public bodies (local and regional authorities, the Norwegian Public Roads Administration, the county governor, the port authorities, the Norwegian Water Resources and Energy Directorate etc.) and sufficient involvement of politicians and decision-makers along the way. If all parties have a shared understanding of the overall objectives, they will take ownership of the planning goal. This will engender effective interaction between the parties and avoid a battle to gain acceptance for their views. This can be achieved by giving an early presentation to the regional planning forum (meeting of all central and regional government agencies to discuss planning proposals and give a steer to local authorities or the developer), but the planning process must have progressed to the point of having specific measures that the different agencies can consider and respond to.

Early dialogue with stakeholders and affected parties

The complexity of the plan to be developed will determine which affected parties and stakeholders must be identified. Who is the end user? A stakeholder analysis will highlight who will be directly impacted and who will only be affected indirectly (there is a special responsibility to ensure the active participation of children, young people, the elderly, people with disabilities and ethnic minorities, see Section 5-1 of the Planning and Building Act). Notification that the planning process is about to commence should be directed at the widest possible target group and announcements of the process should be adapted to the intended target group. The earlier public participation activities beyond the minimum requirements are started, the more effective this involvement will be.

Leader of the planning process must create a positive framework for the project

Under our discussion of opportunities to influence, we pointed to vast differences as regards power and influence. There are also significant differences between the various actors' competence, capacity and resources. It is the responsibility of the leader of the planning process to look after the interests of all actors and to make sure that the power balance never tips in any one direction. This means that the choice of arenas for involvement and public participation is important for the various actors' opportunity to influence. The goal, purpose and premise of the planning process must be established in advance, and everyone involved must be familiar with it. What planning themes are up for discussion must be clear (see next paragraph), the roles of the different actors must be unambiguous, and each planning phase must be given a scheduled time slot. If these matters are clarified at an early stage, the participants will have realistic expectations of the process.

Because many people lack the technical expertise required to read planning maps and zoning regulations, it is important that high-quality information material is created that properly reflects the level of detail that the project team has been working on. This material must be designed in a way that makes it understandable to non-specialists and shows stakeholders and interest groups what physical results they can expect. For the visually impaired, it is important that the planning documents are universally designed because this means they can be read aloud by a screen reader program. According to the Agency for Public Management and eGovernment, 'a universally designed electronic document is therefore a document that can be read by all, irrespective of the reader's functionality, assistive tools and software. In this context, "all" refers to the computer programs that will be processing the documents as well as the people who will be reading them' (Difi, 2010). For the hard of hearing, it is important that the arenas for dialogue and interaction are fitted with a teleloop system, or that a sign language or speech-to-text interpreter is provided. People with cognitive challenges need a simple description of the planning measures, for example through a physical or computer animated model. Good and understandable sketches, drawings, models, pictures and graphics are required to give all affected parties a better basis for considering the proposals.

The right knowledge at the right time in the planning process

Several planning themes affect people's everyday lives, and it is therefore important that input is provided through a public participation process. Affected areas may include outdoor leisure activities, ancient monuments and heritage sites, soil resources, transport needs, public health, accessibility, provisions for children and young people. Once the project has a defined framework, public participation activities can commence, using methods that are suitable for the particular target groups.

- **Making information available,** for instance by public announcement, letter, posts on the local authority's website or by using mass media and digital social platforms.
- **Collecting information**, for instance by analysing local interest groups and actors. This can include place analysis, surveys, interviews, consultation responses and social media.
- **Dialogue**, for instance by organising public meetings, open office days, Kid's Tracks, Youth Tracks, walks with e.g. senior citizens or ramblers' associations, using social media like Facebook or Instagram, brainstorming sessions or future workshops.
- **Cooperation**, for instance by conducting meetings with local councils for young people, senior citizens, and people with disabilities, and with community interest groups, parent teacher associations or local businesses.

Depending on the level of impact the plan will have on the various themes, a suitable public participation plan must be drawn up to ensure that the planner will receive input at the right point in the process.

For example, better coordination of transport modes can be achieved in relation to parking for town bikes and e-scooters near bus and tram stops, railway stations and express boat jetties after receiving input from users of these services. If the input is given at an early stage, the associated costs can be kept at a lower level than if it comes towards the end of the process, when the impact will be more extensive. A plan should also be drawn up for evaluating and discussing alternative proposals that may be put forward during the process, as well as a visual or written summary of all the proposals.

A new national tool has been introduced to assist with the transfer of experience from user groups to planners. Citizens' Tracks is a digital guide designed to help local authorities, developers, planners and designers to conduct better public participation programmes as required under the Planning and Building Act, and to add value to local community development (DOGA, 2019).

Councils for people with disabilities are important partners

Planners carry professional responsibility for ensuring that all groups are heard. Users who sit on councils for people with disabilities can be invited to give their input to the planning process. Their task is to point out challenges, wishes, needs and functional requirements based on their experience. They are important actors in terms of collecting information. The user is the amateur, and the planner is the professional who will ultimately have to decide how to prioritise any conflicting user needs.

An important concluding reflection: Users who contribute to the process are expected to get involved 'everywhere' and to voluntarily give their time and knowledge for free. Other actors who work on the project (architects, engineers, landscape architects, etc.) are paid. Should this be changed?

5. Challenges on the way to good solutions

5.1 Administrative challenges and bureaucracy

Universal design is implemented through the *principle of sector responsibility*. This means that each sector (ministry and directorate) is responsible for universal design within its designated domain. Therefore, the Ministry of Transport, the Directorate of Public Roads and the various transport agencies *(*Norwegian Public Roads Administration, Bane NOR, Norwegian Coastal Administration*)* share responsibility for universal design in the transport and public transport sectors. Each of the three transport agencies has a set of universal design requirements that must be met through measures implemented within their specific area of responsibility. These requirements are additional to the ones specified in the TEK17 building regulations. It can be something of a challenge that concepts and terminology vary across the ministries and directorates involved, and that there is no uniform interpretation of the legislation. The Norwegian Public Roads Administration specify their requirements in their own handbooks, while Bane NOR has published a handbook specifically for railway stations: Håndbok for stasjoner (Jernbaneverket, 2014).

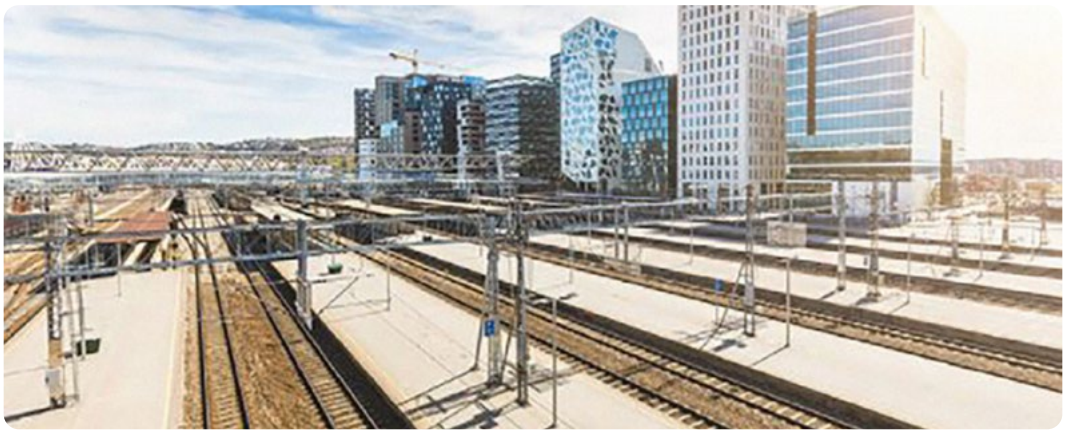
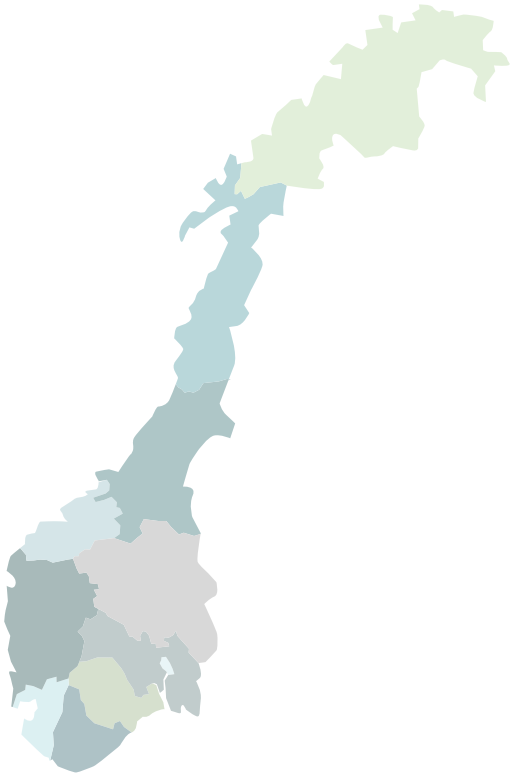


Photo: Håndbok for stasjoner, Bane NOR

Major transport projects often have clear and specific tasks they are supposed to solve, and this is what defines the scope of the project. In order to restrict this scope, the corridors for development are often narrow. It is easy to understand the desire to get as much road as possible for the money, but as planners we often feel that the transition between the new road and its surroundings ends up being less than satisfactory. Linking up new and existing infrastructure is often challenging and sometimes we may even find that there is no link between a new main artery and an existing street in the city centre.

'It is a familiar problem that footways and cycle paths are built alongside new roads, but that they come to a sudden end where the new road links up with the existing road.'

It is a familiar problem that footways and cycle paths are built alongside new roads, but that they come to a sudden end where the new road links up with the existing road. This may be because the areas and feeder roads between new and existing transport developments are owned by local authorities or private entities. This may give rise to extra planning work and higher costs for which there is no budget available under the project. If there is no link between new and existing systems for soft road users, this will have a particularly severe impact on people with impaired orientation or mobility.



Local, regional, and central government should develop a more effective system of interactive working, so that they can work in closer partnership than what is currently the case on plans for areas where all parties are served with high-quality, unifying solutions. This will ensure that no areas are left with poor or non-existent access to transport infrastructure (such as bus stops, footways and cycle paths) because they are located outside the boundaries of the planning area that falls within the remit of the relevant developer/planning authority. In the interest of totality, it is important to develop a system at government level that clarifies who has the coordinating role for universal design. This is particularly important with a view to the National Transport Plan's objective of making complete journey chains universally designed.

To meet challenges associated with administrative and bureaucratic processes, it is important that leaders of planning processes are competent facilitators of effective communication and interaction between all the parties involved. Planners need to be able to speak the technical jargon of the experts but must also be able to talk in a language that is understood by 'the man in the street'. Good results depend on good dialogue.

5.2 Topography and climate

In Norway, land use plans deal with dramatic topography, extreme and changeable weather and local variations. For example, steep gradients and winter maintenance are recurring challenges for which there are no one-size fit all solutions. Solutions that work well on the west coast will not necessarily work well in the eastern parts of the country, or in the far north. For solutions to continue to work well around the clock and throughout the year, it is important that they are simple to service and maintain. Such solutions must be identified at an early stage of the project. Footways that zigzag to

accommodate height differences in the terrain, can also be a challenge because they may involve unattractive landscape interventions. If such interventions are planned for at an early stage, their negative aesthetic impact can be lessened. It may even be possible to construct a flight of steps as a shortcut for those who face challenges in taking a long detour to get from one level to another.

Building transport systems that are suitable for *all people* is a major challenge, but this is nevertheless what planners must aim for as we move towards the goal of creating developments that are **usable for most people**. Unfortunately, it is not always feasible to fully address the challenges presented by Norway's rugged topography and variable weather conditions through planning. If it is the goal of all planning and design efforts to create a product that is useful to the end user, and if the end user is understood to be *'all persons as far as possible'* as per the UN Convention (FN, 2013), then it may perhaps be possible to encompass 'all people' after all? Universal refers to what "generally applies", and universal is not about all people being the same, but about designs that can serve as large a diversity of users as possible (Lid, 2013).

The picture below shows a square in Oslo: Schandorrfs plass (Figure 8). A meandering walkway with incorporated meeting places in a modern parkland setting, providing a pleasant link between the streets of Fredensborgveien and Akersgata.

Figure 8 – Schandorrfs plass, Oslo. Photo: Maritrm (Wikipedia, 2010)

The square is in frequent use by members of the local community for lunch breaks and informal meet-ups, or for taking a bike ride or a stroll with a pram, walker or wheelchair. There is a 7-metre height difference between the two streets, which demonstrates that it is possible to achieve good solutions for challenging urban spaces. The footway gradients are 1:15 and 1:20 (which meets the requirements), and there is a level rest area for every one metre the slope rises. This gives users of manual wheelchairs a break on the way up or down. The square also includes an example of how steps (to the left) and a ramped footway can work as equal solutions for those who move through the area. The visually impaired are guided through the space by natural guide lines. In this instance, guidance fencing has been used, along with a clear contrast between the paving and the kerbs on the adjacent spaces.

'As we move towards the goal of building transport systems that are suitable for everybody, we seek to create developments that are usable to most people.'

Although the picture conveys the appearance of an idyllic space, there are challenges with heavy snowfall in winter, poor snow clearance and slippery surfaces underfoot. This could have been solved, for instance, by installing underground heating to melt the snow and ice. It is normally much easier to identify what is missing, and what does not work well, after a development is completed. However, this clearly illustrates that project evaluation is an important part of the process of making transport infrastructure more universally accessible. The lessons learnt from these experiences can help to inform and improve other projects.

To achieve universal design in zoning plans, planners have various tools available to them, such as:

In respect of physical factors, there are three groups of instruments:

- Physical size and space for movement
- Information (through the senses; vision, hearing, touch, balance, smell, taste, and in respect of cognitive capabilities; sensory perception, awareness, concentration, memory, logical thinking skills, problem-solving and language)
- Avoiding materials that may cause problems

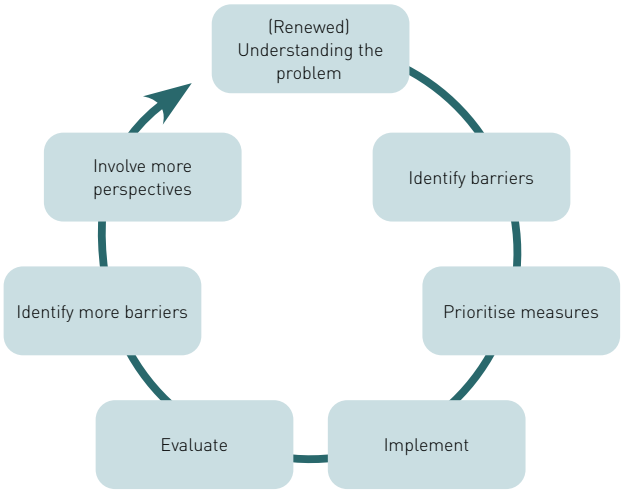
Use the seven principles of universal design, with guidelines, as a checklist:

- Equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use (Lid, 2013, p.65)

Manual V744 about objections in land use planning (Statens vegvesen, 2018)

5.3 Technology is advancing too fast for planning to keep up

New technologies, transport modes and mobility solutions are continually being developed, bringing ever new benefits and challenges. It can be hard for both planners and planning to keep up to date with these developments. To address these challenges, it is useful to 'identify more barriers', which is one of the steps referred to in Figure 5. What would be the implications if more autonomous (driverless) vehicles were introduced in our cities? What infrastructure adjustments and road services would be needed to exploit the opportunities that this new technology represents? If autonomous vehicles can replace private cars in towns and cities, large



areas that are currently set aside for parking could be repurposed. This will help enable planners to design towns and cities where transport systems, public services, residential and commercial areas are better coordinated.Parking areas can, for example, be used to provide better facilities for pedestrians and cyclists. The use of autonomous vehicles may, however, increase road traffic and thereby add to the congestion.

5.4 Temporary obstacles

Apart from all the things that we can plan for and regulate, temporary obstacles can also give rise to challenges. These are often things that planners have no control over, like the seasonal street furniture of outdoor restaurants, benches and advertising boards. Randomly parked e-scooters that frequently fall over are the latest problem. The main challenge created by e-scooters is that they are left in pedestrian zones. They are therefore considered a hazard by the visually impaired and represent an obstacle for anyone pushing a pram or using a walker or wheelchair. It is important that pedestrian zones are kept free of obstacles.

'Challenges represented by temporary obstacles, like the many e-scooters, can be addressed either through dialogue with the various stakeholders or through public regulation.'

Challenges represented by temporary obstacles, like the many e-scooters, can be addressed either through dialogue with the various stakeholders or through public regulation. There are already regulations in place pertaining to wall zones and furniture zones, but despite this, the challenges have not disappeared: outdoor dining facilities pop up every spring, and some advertising boards will inevitably be put in an unfortunate position. It is the authors' opinion that the primary aim should be to ensure that all stakeholders receive correct information: that pedestrian zones must be kept free of traffic. The subsidiary aim is to initiate a dialogue in order to arrive at good, innovative solutions.

6. Conclusion: Universal design – for diversity and equal opportunities for participation in society

Several new guides have been introduced for zoning plan processes, such as a step by step guide for drawing up good zoning plans, Steg for steg – veien til gode reguleringsplaner (*Bygg21, 2019)*. As mentioned in Chapter 4, Design og arkitektur Norge (DOGA, 2019) has launched a national participation platform (Citizens' Tracks), and Oslo local authority has created its own guide on public participation in submitted zoning plans, Medvirkning i innsendte reguleringsplaner (Oslo kommune, 2019). This confirms the authors' own experiences of the complexity and challenges of achieving successful planning processes and public participation. However, it is possible to develop good practices, as indicated in Section 4.

In zoning plan processes, it is crucial to take the time to explore the possibilities for various different alternatives to a solution. If user participation is integrated from the very start of the process, it gives scope to investigate whether changes can be implemented that best address the input received. At the very least, an attempt should be made to address the intention behind the input. The key to success lies in a shared understanding of the goal, which is for designs to be aimed at the broadest diversity of users as possible. In doing so, participation becomes a tool for safeguarding inclusion and a means to achieving a society characterised by equality and equal opportunities (Lid, 2013).

'When considering universal design in a long-term perspective, sustainability is the key to viability. Effective, robust solutions that are both used and maintained are sustainable.'

Choosing effective, adapted solutions and durable, recyclable materials can help ensure ecological and economic sustainability in projects.

For instance, well-designed access roads to bus stops will help to increase usage while simplifying servicing and maintenance. Universally designed bus stops can enable more people, regardless of their disability, to meet and take the bus to work or participate in leisure activities with others.

'Meeting places, such as squares, urban spaces or benches that welcome people, contribute to social sustainability.'

In combination, this can contribute to greater freedom, a better quality of life and increased participation in social environments.

The authors recognise the need for a change in attitudes if we are to achieve the UN's principle of 'Leave no one behind'. Unfortunately, people with disabilities are still being discriminated against every day. To combat this, it is essential that everyone involved in planning and designing transport facilities is able to ***identify with the users***, thereby creating space for the diverse population. We must adhere to laws, regulations, guides and manuals, but it is crucial to see the requirements in a broader context. Instead of sticking to minimum requirements and being satisfied that all the points on the checklist have been ticked off, we should, where possible, strive for even better solutions than those described in the applicable laws and regulations. Universal design is more than a minimum standard for technical solutions.

'Universal design is more than a minimum standard for technical solutions.'

In order to create a more inclusive, equitable and sustainable transport system, both public participation and universal design are essential tools for ensuring that everyone can participate in society, and that no one is left behind. Not forgetting SDG 17: Partnerships for the goals.

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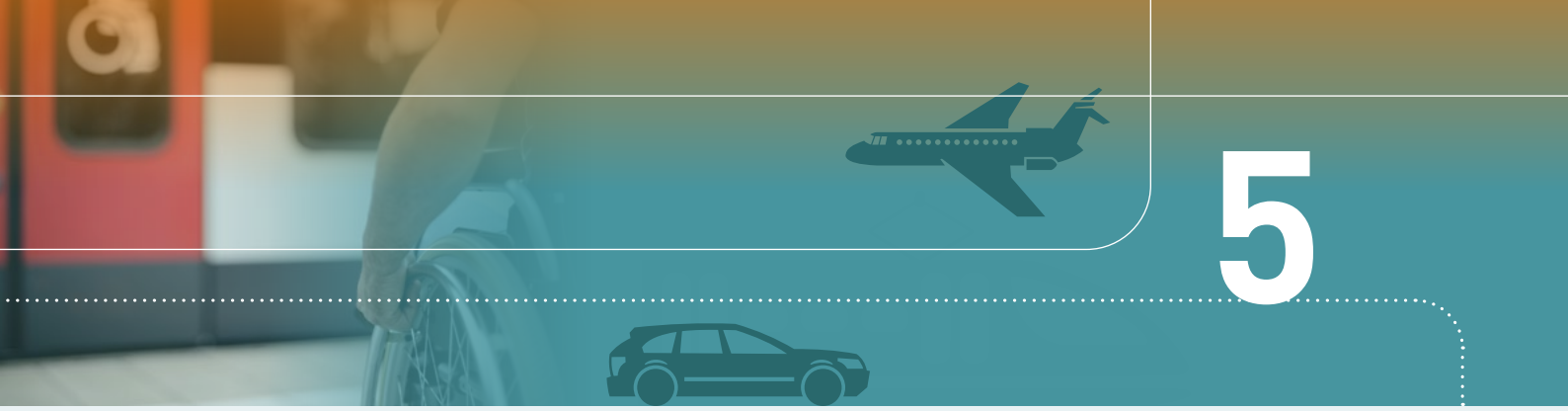

5

How can we ensure universal design of trip chains in a system with complex laws, regulations and responsibilities?

KJERSTI VISNES ØKSENHOLT AND JULIE RUNDE KROGSTAD

This article aims to provide the reader with an introduction to the legal and organisational framework for universal design in the Norwegian transport sector, with a particular focus on trip chains. The goal is to illustrate how the framework is structured and functions, as well as to enhance understanding of the laws, regulations and responsibilities that underlie universal design in trip chains. Finally, it discusses how to ensure universal design of the transport system in the face of complex legislation and responsibilities and shifting accountabilities as a result of reforms within the transport sector.

Kjersti Visnes Øksenholt

Kjersti Visnes Øksenholt is a human geographer and former senior researcher at the Institute of Transport Economics. She has worked for several years on integrated land use and transport planning, regional and urban development anduniversal design.

Julie Runde Krogstad

Julie Runde Krogstad is a political scientist and senior researcher at NORCE Norwegian Research Centre. She previously worked as a senior researcher at the Institute of Transport Economics. She has been involved in the organisation of the transport sector and sustainable transport for several years.

1. Introduction

Stringent statutory requirements are in place for universal design in the transport sector. This includes requirements for the design of footways, safe road crossings, winter maintenance, and proper lighting and colour contrasts. Public transport is subject to requirements for the design of stops (bus stops, stations/platforms, ferry quays, etc.) and the access to these, the design of vehicles and user interfaces on ticketing systems (which can vary across the different modes of transport in a journey). A multitude of stakeholders are responsible for the different elements of the trip chain, and they need to work together to ensure universal design in transport.

If a journey involves public transport, the complexity of responsibility increases. There have been several changes in legislation, regulations and the distribution of responsibilities in recent years that affect the overall perspective on the universal design of the trip chain.

Public transport involves trip chains that consist of multiple segments, where each individual segment impacts on the passenger's ability to complete the journey successfully. If a single segment of the trip chain is not universally designed or does not meet the individual's accessibility requirements, it can disrupt the entire trip chain and make the journey impossible or difficult to complete. A universally designed transport system is particularly crucial for people with disabilities, but it also benefits other travellers.

'If a single segment of the trip chain is not universally designed or does not meet the individual's accessibility requirements, it can disrupt the entire chain and make the trip impossible or difficult to complete.'

A trip chain consists of elements such as footways to and from public transport stops, the stops themselves, information, ticketing and vehicles. In each of these elements, there can be multiple responsible parties depending on the mode of transport (bus, tram, train, boat, etc.) and the type of road (privately owned, or owned by the local or county authority or the government).

Figure 1 illustrates who is responsible for the various elements in a trip chain, with examples from public transport by road and rail. Stakeholders can also be divided into different agencies and departments, further complicating the picture.

Equality and Anti-Discrimination Act: 'All groups in the population shall have equal opportunities and rights to participate in all aspect of society, regardless of their abilities'.

Roads to and from stops/stations/ transport hubs

- County authority
- Local authority
- Government
- Private

Photo: Ruter As/Redink/ Hampus Lundgren

Information and travel planning

- Administration company/ county authority
- Operating company
- EnTur AS
- Dane NOR SF

Photo: Ruter As/Nucleus AS/ Daniel Jacobsen

Stops/stations/ transport hubs

- County authority
- Local authority
- Norwegian Public Roads Administration
- Bane NOR SF

Photo: Ruter As/Nucleus AS/ Daniel Jacobsen

Ticketing

- Administration company / County authority
- Operating company
- EnTur AS

Photo: Shutterstock

Modes of transport

- Operating company
- Administration company / County authority
- Norske Tog AS

Photo: Ruter As/Nucleus AS/ Daniel Jacobsen

2. Laws, regulations and standards

All segments of the population must have equal opportunities and rights to participate in all aspects of society, regardless of their functional ability. This sums up the overarching goal of the Equality and Anti-Discrimination Act, which sets requirements for universal design.

Photo: Peter Mydske/Stortinget

Numerous laws and regulations govern and impact on various aspects of universal design in the transport sector. Laws are general legal rules that have been enacted by Norwegian Parliament (the Storting), while regulations are legally binding provisions that are established by public authorities based on the applicable legislation.

Laws are general legal rules that have been enacted by Norwegian Parliament (the Storting), while regulations are legally binding provisions that are established by public authorities based on the applicable legislation.

Over the past decade, requirements in Norwegian legislation have been tightened, as the EU has adopted a series of regulations and directives that strengthen the rights of people with disabilities. Norwegian legislation is influenced by EU regulations via the EEA Agreement, which is the cornerstone of Norway's cooperation with the EU. A regulation adopted in the EU becomes legally binding in its entirety in the member states without the need for it to be approved in the individual country. Directives set out goals and conditions within a specific area of activity, and member states must incorporate these into their national statutory framework within a set deadline.

Norwegian legislation is influenced by EU regulations

EU regulations can be incorporated into Norwegian legislation in one of two ways:

- The relevant legislation is directly incorporated into Norwegian law through a regulation stating that the EU regulation shall be implemented (incorporation)
- The provisions are rewritten into Norwegian law or adapted for existing legislation (transformation)

An example of a regulation that has been incorporated into Norwegian law is the TSI PRM (Technical specifications for interoperability relating to accessibility of the Union's rail system for persons with disabilities and persons with reduced mobility), which has been included as a separate regulation (FOR-2015-09-28-1131). TSI PRM imposes requirements for railway buildings and vehicles, but it also states that if stricter requirements are set in national regulations, these take precedence.

The current regulatory framework is fragmented and, in some cases, lacks specificity. This is partly due to the gradual tightening of Norwegian law alongside the implementation of EU legislation, as well as the complexity of the transport system, which inherently necessitates compliance with various laws, regulations and recommendations.

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Keeping track of what is legally mandated and what is recommended can be a challenge for authorities. Requirements and recommendations have also evolved gradually over many years as new knowledge has emerged. Several voluntary standards have been established, but these often provide more detailed descriptions than laws and regulations.

Figure 2 shows a selection of laws, regulations and standards that are central to each of the different elements in a trip chain.

Photo: Ruter As/Redink/Hampus Lundgren

- **Roads to and from stops/ stations/transport hubs**
- The Roads Act
- Manual N100: Road and street design
- Manual V129: Universal design of roads and streets
- NS 11033: Universal design – Passenger transport – Transport services

Photo: Ruter As/Nucleus AS/ Daniel Jacobsen

- **Information and travel planning**
- Regulation for universal design of ICT solutions
- EU Regulation concerning the rights of passengers in bus and coach transport/the Professional Transport Act
- NS 11032: Universal design – Passenger transport – Requirements for transport providers on passenger rights

Photo: Ruter As/Nucleus AS/Daniel Jacobsen

- **Stops/stations/transport hubs**
- The Planning and Building Act
- Regulations on technical requirements for construction works
- Manual N100: Road and street design
- TSI PRM
- Bane NOR's Manual for railway stations

Photo: Shutterstock

- **Ticketing**
- Regulation for universal design of ICT solutions
- EU Regulation concerning the rights of passengers in bus and coach transport/the Professional Transport Act
- NS 11032: Universal design – Passenger transport – Requirements for transport providers on passenger rights
- NS 11033: Universal design – Passenger transport – Transport services

Photo: Ruter As/Nucleus AS/ Daniel Jacobsen

- **Modes of transport**
- Regulation on the universal design of licensed motor vehicles
- The Public Procurement Act
- NS 11031: Universal design – Requirements for the design of buses
- TSI PRM
- Guide to universal design in maritime passenger transport

2.1 Laws

Equality and Anti-Discrimination Act

The Act relating to equality and a prohibition against discrimination (Equality and Anti-Discrimination Act) is the central overarching legislation that imposes requirements for universal design in all areas of society. The act provides for the inclusion of all population groups in society and safeguards against discrimination. The purpose of the act is (Section 1):

> *'To promote equality and prevent discrimination on the basis of [...] disability, [...]. "Equality" means equal status, equal opportunities and equal rights. Equality presupposes accessibility and accommodation. [...] This Act shall help to dismantle disabling barriers created by society and prevent new ones from being created.'*

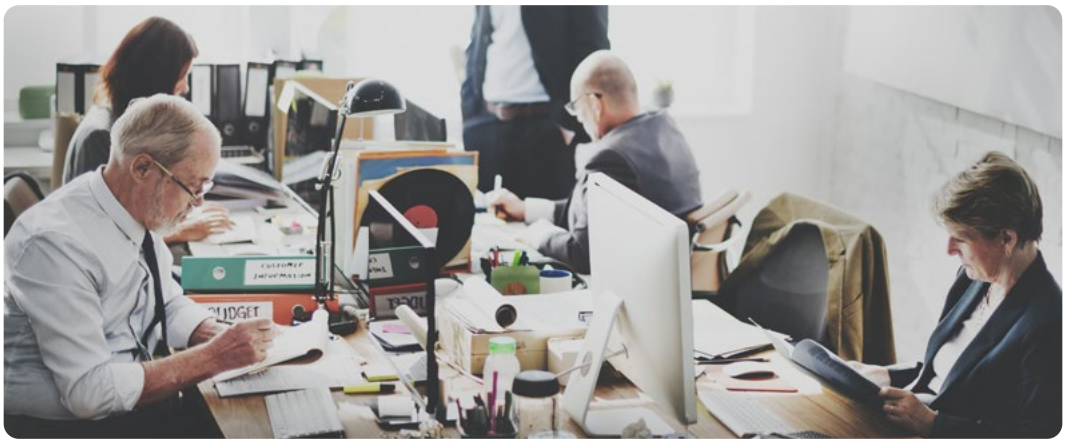
The Equality and Anti-Discrimination Act is, therefore, a framework that imposes requirements for universal design in all areas of society. The act explicitly prohibits discrimination, which is understood as direct or indirect differential treatment. The act also includes a chapter dedicated to universal design and individual accommodation (Chapter 3), where both individual rights and the obligations of public and private entities are detailed. It also establishes requirements for the universal design of the transport system, based on Section 17, which states that:

> *'Public and private entities that cater to the general public have a responsibility to ensure that their core functions incorporate universal design principles. "Universal design" refers to the process of designing or adapting the primary solutions, considering physical conditions, including information and communication technology (ICT), to ensure that the essential functions of the undertaking can be used by as many people as possible, irrespective of disability.'*

While the act is intended to promote equality and prevent discrimination, there is nevertheless a risk that interpretations may vary, and some people may continue to feel discriminated against. In such cases, the Anti-Discrimination Tribunal – a neutral administrative body – will adjudicate appeals.

Planning and Building Act

The Act relating to planning and the processing of building applications (Planning and Building Act) aims to **'promote sustainable development in the best interests of individuals, society and future generations'.** It is central to land use planning and the processing of building applications. The act aims to facilitate the coordination of the work of central, regional and local authorities, while also ensuring that building works comply with laws, regulations and planning decisions, and that each measure is implemented responsibly.



When considering universal design in the transportation system, the Planning and Building Act is pertinent to ensuring accessibility to public transport stops, as well as the design of these stops, platforms, terminal buildings and transfer hubs. Even if land intended for transportation purposes is planned in accordance with the Roads Act, the regulations mandating that planning processes must adhere to the Planning and Building Act still remain in effect.

Section 1-1 'Purpose of the Act' states that both universal design and participation shall be safeguarded and ensured:

> *'Planning and administrative decisions shall ensure transparency, predictability and public participation for all affected interests and authorities. There shall be emphasis on long-term solutions, and environmental and social impacts shall be described. The principle of universal design shall be taken into account in planning and in requirements relating to individual building projects.'*

A distinction is drawn between general participation (public disclosure) and active involvement by groups requiring special facilitation (Section 5.1), for which the local authority holds a specific responsibility. Works that are subject to application under the Planning and Building Act, they shall:

> *'Within their designated functions, they must be universally designed in accordance with the regulations issued by the Ministry. These works should not pose any danger and should meet the necessary safety, evacuation, health and environmental requirements , as stipulated by the law or in accordance with the law* (Section 29-3).

Under the law, orders for improving universal design in existing buildings and installations can be issued if there are compelling reasons for doing so.

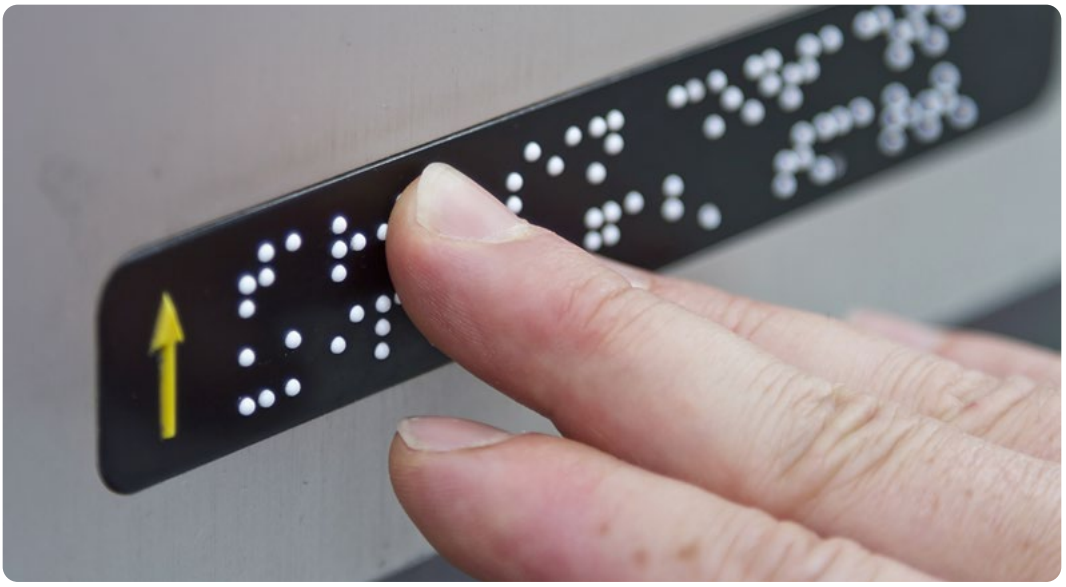
The Roads Act

The Act relating to Roads (Roads Act) aims to **'ensure the planning, construction, maintenance and operation of public and private roads in a manner that can benefit road users and society at any given time'**. Section 13 of the Roads Act requires the construction of public roads to adhere to road standards. The Norwegian Public Roads Administration is responsible for developing these road standards.

The Public Procurement Act

The Act relating to Public Procurements (Public Procurement Act) regulates public procurement in Norway. Section 5 describes how governmental, regional and local entities, as well as public law bodies should structure their procurement practices, and that

'The contracting authority shall impose requirements for universal design in public contracts in accordance with the rules set out in regulations'.



Other laws

There are also several important laws that impose requirements on transportation by various modes of transport. The purpose of these laws includes regulating transport operations and ensuring quality. The following laws provide legal authority for several important Norwegian and EU regulations related to the design of vehicles and passenger rights:

- **The Professional Transport Act**
- **The Aviation Act**
- **The Railways Act**
- **The Norwegian Maritime Code**
- **The Ship Safety and Security Act**

2.2 Norwegian regulations

Regulations on technical requirements for construction works

The Regulations on technical requirements for construction works (*Forskrift om tekniske krav til byggverk (TEK)*) are founded on the Planning and Building Act. The purpose (Section 1-1) is to:

'ensure that works are planned, designed and carried out with regard to good visual quality, universal design, and so that they meet technical requirements for safety, environment, health and energy'.

In relation to universal design in the transport system, these regulations are particularly relevant for the design of terminal buildings, transfer hubs, roadside picnic areas/toilets and developed outdoor spaces.

The most recent version of the regulations imposes requirements for universal design in:

- **Developed outdoor spaces:** for the general public; for residential buildings that require a lift; for construction works for the general public and work buildings (Section 8-2).
- **Construction works for the general public and work buildings,** unless the construction work or parts of the construction work is, given its function, unsuitable for people with disabilities (Section 12-1).

Specific requirements are also set for floor plans and building components in construction works: Entrances (Section 12-4); Communication routes (Section 12-6); Rooms and other areas for people (Section 12-7); Entrance halls and cloakrooms (Section 12-8); Bathrooms and toilets (Section 12-9); Balconies, terraces and similar (Section 12-11); Waste system and separation of waste (Section12-12); Doors, gates and similar (Section 12-13); Stairs (Section 12-14); Ramps (Section 12-16); Windows and other glazed areas (Section 12-17); Signage, control and operating panels, handles, fittings and similar (Section 12-18). These requirements concern, for example, physical design, width, height and placement of control panels, etc., tactile and visual marking of warning areas and awareness areas, luminance contrast and safeguards.

Regulations on the construction of public roads

The Regulations on the construction of public roads are founded on the Roads Act and are intended to regulate the design and standards for the planning and construction of public roads and streets. The regulations address road standards (Section 3), which are intended to ensure

'Efficient and safe carriage of people and goods, and the best possible adaptation to buildings, living environments, urban environments, landscapes, biodiversity, cultural heritage, vegetation and agricultural areas.'

In terms of the design of roads and streets, the current road standard in Norway is N100 Road and street design. This standard primarily applies when a new road is to be built or when an existing road is subject to major improvement works. There is no defined standard for minor improvements works or spot improvements.

Universal design of public transport vehicles

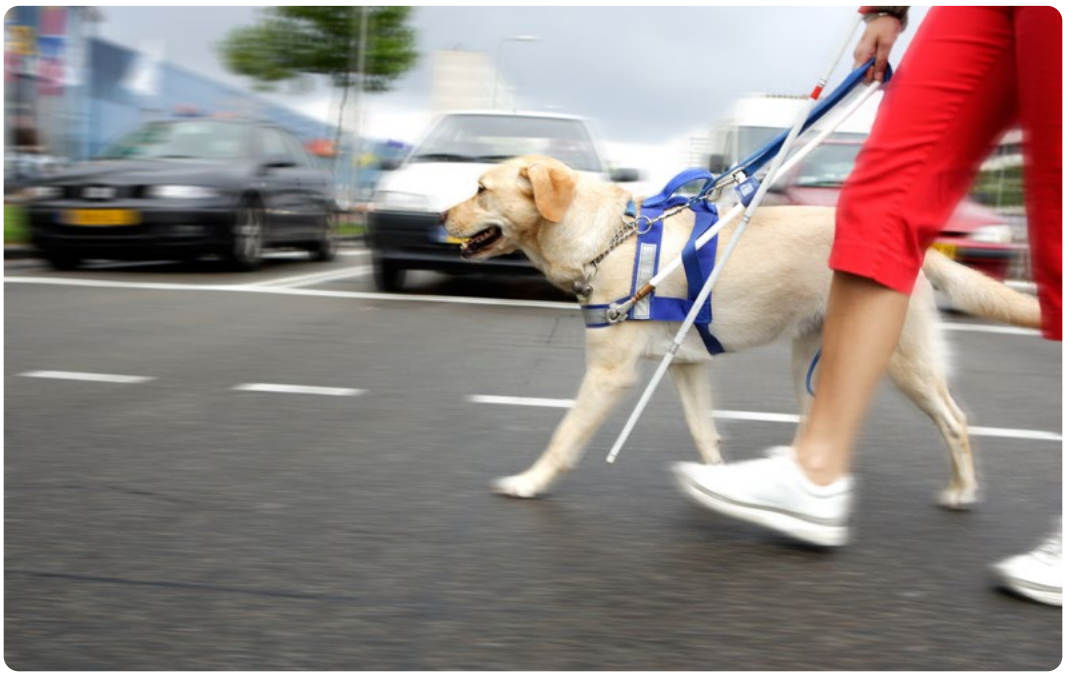
Universal design of public transport vehicles is provided for in regulations founded on the Professional Transport Act, the Railways Act and the Norwegian Maritime Code.

- **The Regulation on the universal design of licensed motor vehicles** is founded on the Professional Transport Act.
- **The Regulation relating to requirements for tramways, metros, suburban railways etc. (Requirements Regulation)** is founded on the Railways Act.
- **The Regulation relating to the implementation of Commission Regulation (EU) No 1300/2014** [TSI PRM] is founded on the Railways Act.
- **The Regulation on the construction of ships is founded on** the Ship Safety and Security Act.

Passenger rights

Passenger rights for users of the various modes of transport have been secured through a series of EU regulations. These regulations aim to ensure, for example, requirements for and high quality in the assistance offered to people with disabilities, non-discriminatory access to transport and the training of personnel. In general, the rights of people with reduced function and mobility have been strengthened as a result of several changes. The regulations that have been adopted are as follows:

- **The EU Regulation concerning the rights of passengers in bus and coach transport** was adopted in 2011 and is founded on the Professional Transport Act and the Regulation on the Transport Complaints Board for passenger transport.
- **The EU Regulation concerning the rights of passengers when travelling by sea and inland waterway** was adopted in 2016 and is founded on the Norwegian Maritime Code.
- **The EU Regulation concerning the rights of disabled persons and persons with reduced mobility when travelling by air** was adopted in 2006. This regulation has been adopted in the form of the Regulation on the universal design of airports, and on the rights of disabled people and people with reduced mobility in air transport, and is founded on the Aviation Act.
- **The EU Regulation on rail passengers' rights and obligations** was adopted in 2007 and amended in 2018, and is founded on the Railways Act.



Regulation on the Passenger Complaint Handling Bodies for passenger transport

The Regulation on the Passenger Complaints Handling Body for passenger transport is founded on the Professional Transport Act, the Railways Act and the Aviation Act. The regulation sets out the mandate of the Passenger Complaints Handling Body, which 'shall ensure reasonable, fair and expeditious resolution of disputes between passengers and service providers that fall within the Board's remit. The Passenger Complaints Body shall contribute to the dissemination of general knowledge about passenger rights.'

Regulation for universal design of ICT solutions

The Regulation for universal design of ICT solutions is founded on the Equality and Anti-Discrimination Act and sets requirements for the design of online solutions and self-service machines to ensure universal accessibility without causing a disproportionate burden to businesses. The regulation states that

> 'Enterprises in the training and education sector are obligated to implement universal design in new ICT solutions no later than 12 months after January 1, 2018. Existing ICT solutions must also comply with universal design standards by January 1, 2021.'

Furthermore, there is a likelihood that the EU's Web Accessibility Directive (WAD) will be adopted[1], but the method of adoption, whether through incorporation or adaptation (transformation) of existing regulations, has not been determined.

2.3 Standards and guidelines

This section gives an overview of standards and guidelines that provide technical specifications for universal design in the transport sector.

Norway's statutory framework is complex, and establishing an overview of all applicable requirements can be challenging. Therefore, guidelines and standards that provide more detailed technical specifications can be helpful. Standards Norway develops and manages standards in Norway and holds exclusive rights to the product name '*Norsk Standard*' (Norwegian Standards). These standards can be appended to

1 WAD largely imposes the same requirements as those already established by Norwegian law but also introduces several new requirements. National implementation has not yet been approved. More details are available here: https://uu.difi.no/krav-og-regelverk/eus-webdirektiv-wad

contracts or used when contracting parties and operators enter into agreements or in tender documents.

Standards

When it comes to universal design, the European Committee for Standardization (CEN) has appointed a strategic advisory group to work on the inclusion of universal design in all relevant standardisation efforts. Because standards are flexible instruments that are regularly created, amended and updated, it is not possible to provide a complete overview of them. However, Standards Norway has standards within the following areas that can be particularly useful in the transport sector:

- **Universal design of construction works -** for the general public and work buildings, which specify requirements for public buildings and adjacent parking and access.
- **Universal design of outdoor spaces**, which covers developed areas in connection with buildings, green infrastructure and transport facilities.
- **Requirements for bus design**, which specify and expand on statutory requirements for the universal design of buses.
- **Passenger rights**, which set requirements for contracting parties and transport operators that protect user rights in passenger transport.
- **Self-service machines for use by the public** - Requirements for physical design and user interaction, which address the requirements for universal design of self-service machines.

Guidelines

There are also numerous guidelines aimed at assisting in the work with universal design in the transport sector.

'Manual 129 - Universal design of roads and streets describes the main principles for achieving universal design in planning, construction, operation and maintenance, and provides guidance on the design of roads and streets, equipment and roadside facilities.'

Drawn up by the Norwegian Public Roads Administration, this guide describes in more detail how the requirements in the road standard can be met. Bane NOR has a manual for railway stations, which presents requirements, recommendations and guidelines related to standards for public areas at railway stations. Universell Utforming AS has drawn up the Guide to universal design in maritime passenger transport as well as a checklist based on statutory requirements. The Norwegian Asthma and Allergy Association has drawn up the guide Universal design of buildings – for people with asthma, allergies and other sensitivities, which will be relevant for transport hubs and stations.

3. Stakeholders, roles and responsibilities

The responsibility for universal design in the various parts of the transport system is distributed between various tiers of government and stakeholders. The authorities in the various levels of government have the discretion to choose how they want to organise this work, whether they want to handle it internally or outsource it by establishing wholly-owned enterprises or limited companies.

'Achieving universal design requires interdisciplinary collaboration across governmental, regional and local entities. Each entity must have independent responsibility for internal coordination and ensure implementation, competence enhancement and awareness-raising (Ministry of the Environment, 2009).'

3.1 Government authorities

At the government level, ministries and directorates influence the universal design efforts in the transport sector by establishing framework conditions through laws, regulations, guides and guidelines that lower levels of government and other stakeholders must adhere to. Additionally, the government is responsible for overseeing various aspects of the transport system, such as mapping, planning, development, administration, operation and maintenance.

- The Ministry of Culture has overall responsibility for equality and non-discrimination. The work on universal design in the Norwegian Directorate for Children, Youth and Family Affairs[2] (Bufdir) falls under the Ministry of Culture. Bufdir is responsible for implementing government policy in this area, disbursing grants for universal design projects, and working on competence enhancement, while also managing various networks for universal design (including areas such as construction, ICT and public transport).
- The Ministry of Local Government and Regional Development is responsible for planning and impact assessments under the Planning and Building Act, housing and building policies, as well as ICT policies and the digitalisation of the public sector. The following directorates and agencies are subordinate to the Ministry of Local Government and Regional Development.
- The Norwegian Building Authority is responsible for ensuring environmentally friendly and accessible housing and buildings, as well as improving knowledge about building regulations and the building application process. It has, for instance, drawn up a guide for the most recent version of the Regulations on technical requirements for construction works. **The Norwegian Digitalisation Agency** (Digdir) aims to contribute to rapid and coordinated digitalisation of the public sector and the expedient digitalisation of society.
- The Authority for Universal Design of ICT falls under Digdir and is responsible for ensuring that online solutions and self-service machines can be used by everyone.
- The Norwegian Mapping Authority helps to map accessibility and universal design in cities, towns, urban areas and recreational areas.
- The county governors are the government's representatives in the county authorities, and they are responsible for following up administrative decisions, goals and guidelines issued by the Storting and the government. The county governors follow up on governmental initiatives by

2 As a directorate, Bufdir is subordinate to the Ministry of Children and Families.

contributing to the incorporation of universal design into regional and municipal plans. The county governors also give advice and guidance on universal design to regional and municipal partners, as well as voluntary groups, organisations and service user groups.

- The Ministry of Transport has overall responsibility for national transport policy. It is also responsible for policy development and administration related to aviation, national roads, national road ferries and railways. The core tasks of the Ministry of Transport include long-term planning, investigation, analysis, legislation, regulations, licences and budgeting in these areas. Several directorates fall under the Ministry of Transport, with responsibilities for managing national roads, national road ferries, railways and aviation. Some tasks have been assigned to state-owned enterprises and limited companies. The key stakeholders are described in more detail below, and all of these are subordinate to or wholly owned by the Ministry of Transport. In addition to these, there are also various supervisory authorities (such as the Civil Aviation Authority of Norway, the Norwegian Railway Authority, etc.), which are responsible for ensuring various entities' regulatory compliance.
- The Norwegian Public Roads Administration is responsible for the national road network and the associated infrastructure, national road ferries, operation and maintenance. Its mission is to develop and facilitate an efficient, environmentally friendly, forward-looking and safe transport system. In addition, the Norwegian Public Roads Administration has sectoral responsibility for traffic safety, climate and environmental matters, and overarching urban policies, as well as national responsibility for coordination and oversight in public transport (Ministry of Transport, 2019). The Norwegian Public Roads Administration consists of the Directorate of Publics Roads (authoritative body) and six divisions. In the letter of award for 2020,[3] universally designed trip chains are an interim target under the overarching goal of accessibility. The indicators for this work are the number of bus/tram stops on the national road network and the number of universally design public transport hubs.
- Nye Veier AS is a limited company with responsibility for developing the national road network. The company plans, constructs, operates and maintains safe national roads. Nye Veier was founded in 2016 with the goal of creating a 'lean, efficient and specialised construction and project management organisation', and took over four development projects from the Norwegian Public Roads Administration. Since then, the company has been awarded several other projects.
- The Norwegian Railway Directorate is responsible for managing and coordinating the railway sector, developing the railway system, and defining and procuring services related to infrastructure, passenger traffic and rolling stock. It is also responsible for coordinating the cooperation between the different stakeholders in the railway sector. The aim is for the railway sector to be operated as effectively, safely and environmentally friendly as possible for the benefit of passengers, freight transport and society.
- Bane NOR SF is a state-owned enterprise with responsibility for railway infrastructure. It is also responsible for the planning, development, management, operation and maintenance of the rail network, traffic control and the management and development of railway properties.
- Several state-owned limited companies were established when the railway sector was restructured in 2017. The companies relevant to universal design are EnTur AS and Norske Tog AS. EnTur owns and manages the ticket sales system for trains and collects information about public transport in Norway to make it easier to choose sustainable travel options. Norske Tog procures and owns rolling stock and leases it to companies operating passenger transport on the Norwegian railway.
- Avinor AS is a limited company with responsibility for airports in Norway. Avinor aims to have all of its airports universally designed by 2025. Seventy to eighty per cent of universal design requirements are met by the major airports, but some of the older airports still work to older regulations that do not adequately address universal design.

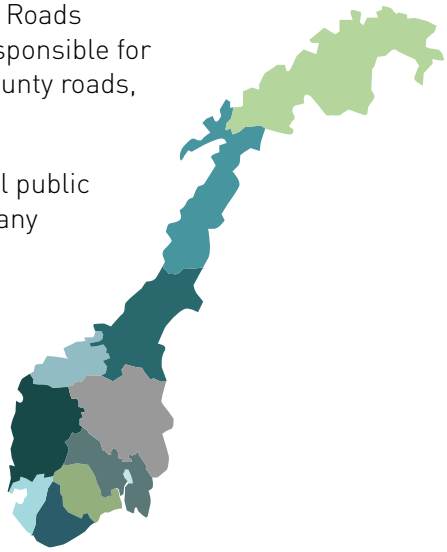
3 https://www.regjeringen.no/contentassets/087954c97c8e47b7b2a733e350a25b4a/tildelingsbrev-statens- vegvesen-2020.pdf

3.2 Regional level

The regional governments are Norway's largest road owners and are responsible for the county road network and for providing and facilitating public transport services. They are also tasked with regional planning, which is a key tool for setting goals and providing strategic direction for their activities and influencing local authorities' land use and community planning. This makes the regional government an important stakeholder in the field of universal design in the transport sector.

'Regional governments are responsible for the construction, upgrading, operation and maintenance of roads, bus stops and public transport terminals along county roads.'

Regional governments own and manage the county road networks and associated infrastructure. They took over responsibility for the majority of the current county road network in 2010. Additionally, as part of the regional reform in 2020, they assumed responsibility for managing, planning, constructing, operating and maintaining the roads, which was previously held by the Norwegian Public Roads Administration. As a result, regional governments are now responsible for the construction, upgrading, operation and maintenance of county roads, bus stops and public transport terminals.



Regional governments provide and facilitate local and regional public transport services (except trains and national road ferries). Many authorities have chosen to establish limited companies or enterprises to manage public transport, such as Ruter, Kolumbus and AtB.

Some regional governments have established public transport departments within their government administration. Nowadays, all or most public transport services are subject to competitive tendering, which has led to a shift from *net contracts*[4] to *gross contracts*. In this transition, most regional governments have opted for gross contracts, thereby taking over the planning and marketing of public transport services. These authorities now possess considerable expertise in public transport planning and have overall responsibility for universal design, including specifying vehicle requirements in contracts, overseeing ticketing, and providing information.

'Regional authorities now possess considerable expertise in public transport planning and have overall responsibility for universal design, including specifying vehicle requirements in contracts, overseeing ticketing, and providing information.'

The operating companies are solely responsible for training drivers in providing good passenger care. However, unlike trains and trams, buses rely heavily on the drivers for ensuring accessibility, making it crucial for operating companies to closely monitor and support their drivers in achieving universal design in bus services.

A survey on universal design in regional public transport revealed that regional authorities prioritise vehicles, bus stops, ticketing and information systems in their work on universal design. However, there was less emphasis on evaluating implemented measures, competence development, winter maintenance and pedestrian access to bus stops.

4 In net contracts, the operator receives the ticket revenue and therefore gives a bid for the net cost (after deducting revenues) when responding to tenders. In gross contracts, the ticket revenue goes to the contracting authority (the county authority), so service providers only give a bid for the (gross) operating cost.

Photo: Hampus Lundgren/Redink

3.3 Local level

While the regional authorities own and manage the county road network and associated infrastructure, it is the responsibility of local authorities to manage the municipal road network and associated infrastructure. Along municipal roads, local authorities are thus responsible for ensuring universal design in the construction and upgrading of access roads to bus and tram stops, as well as at the stops themselves, and for their operation and maintenance.

Local authorities are responsible for land use planning and ensuring that, within their own municipality, it is in line with the principles of universal design. In addition, the local authority can adopt requirements for universal design in both the land use element of the municipal master plan and in zoning plans.

> *'The municipality may, independently of land-use objectives, adopt provisions for the land-use element of the municipal master plan regarding [...] functional requirements, including provisions for design for universal access [...].'*
> Planning and Building Act (Section 11-9)

> 'Provisions can be included concerning land use and zones requiring special consideration in regard to functional and quality requirements, relating to buildings, installations and outdoor areas, including requirements for the protection of health, the environment, safety, design for universal access and children's particular need for play and public outdoor areas.'
> Planning and Building Act (Section 12-7)

In addition, the local authority processes building applications and is responsible for assessing whether construction, extensions, upgrades, substructures and the siting of buildings, structures and facilities comply with administrative decisions, regulations and the Planning and Building Act. As the planning authority and developer, employees across all of the local authority's service areas (planning, building applications, technical departments, etc.) must have sufficient expertise in universal design.

3.4 Private entities

In addition to the responsibilities of various tiers of government, several private entities also need to have a good understanding of universal design in the transport system.

The operating companies run the public transport service on behalf of the contracting authority. The Norwegian Railway Directorate has divided the rail network into various traffic packages, where the services are run by different train operators. The contracts stipulate that the operating companies, in collaboration with relevant parties, shall seek suitable solutions for universal design in the railway sector (e.g. services, rolling stock).

'A regional authority often divides its jurisdiction into several tender areas and may, therefore, have contracts with different operators – even in the same urban area.'

Because the regional authority or its public transport company plans the routes and markets the services, customers may not necessarily understand that different operating companies are running the services in the various tender areas. It is bus drivers and personnel employed by the different operating companies who interact with passengers on a daily basis and play a crucial role in providing service and creating a pleasant public transport experience for their passengers.

Consultants, architects and construction companies who assist the authorities in the planning, design and construction phases as well as during operation and maintenance, also play a vital role in ensuring compliance with requirements and guidelines. Such parties can be involved in various projects that consist of each individual element in a universally designed trip chain, from the consultant who assisted with information and ticketing to the construction company that built the public transport terminal, the bus stop or the access road to and from it. Systematic cooperation across the trip chain can be challenging due to the involvement of numerous stakeholders and the fact that works often entail the upgrading of a single link in the trip chain. It is therefore particularly important to give special consideration to passenger transfers from one link to another in such projects.

4. How can reforms impact on universal design work?

A complex regulatory framework and a multitude of stakeholders with various roles and responsibilities form the basis for the continuous development of a universally designed transport system.

The framework is constantly evolving in line with political objectives and societal change. Since the 1980s, the public sector in Norway has seen an increase in the involvement of independent entities.

'Public agencies have been reorganised into more autonomous entities that are not subject to direct political control, such as enterprises or limited companies.'

Public agencies have undergone a reorganisation process, resulting in the formation of more autonomous entities that are not directly influenced by political control. These entities, which include enterprises and limited companies remain fully owned by public authorities. However, their organisational structure provides them with increased flexibility and opportunities to realize overarching political goals. Such an arrangement necessitates less direct governance and collaboration among stakeholders.

4.1 Changes in the road sector

Two major reforms, namely the Road Reform (Ministry of Transport, 2015a) and the Regional Reform, were implemented during the tenure of the previous Prime Minister of Norway, Erna Solberg (2013–202), which significantly impacted the road sector. The Regional Reform saw the transfer of the old state road administration (*Sams vegadministrasjon*) to the new county authorities in 2020 (The Ministry of Local Government and Modernisation, 2016). As a result, the distribution of responsibilities within the road sector has undergone significant changes.

'Due to the reforms implemented in the road sector in Norway, the Norwegian Public Roads Administration's overarching responsibility has been significantly reduced. The responsibility for universal design in the sector has been distributed among multiple stakeholders as a result of this change.'

The Road Reform established Nye Veier as a limited company with responsibility for planning, building, operating and maintaining safe national roads. Nye Veier is thus also responsible for infrastructure connected to national roads, such as bus stops. The company's primary mission is to achieve comprehensive development and greater cost-effectiveness (Ministry of Transport, 2015a). This may result in solutions and standards being challenged more than before.

The regional authorities are the largest road owners in Norway since the transfer of 44,000 km of road in 2010 from the government to the regional level, as part of the Administrative Reform.[5] However, the Norwegian Public Roads Administration was responsible for the administration of county roads until 2020, when administrative responsibility for county roads was transferred to the new regional authorities.

Since the Norwegian Public Roads Administration had a broader responsibility and specialized expertise in designing solutions for the road network in the past, the administrative responsibilities have now been divided between the government and the regional authorities. As a consequence of the administrative division, there is no longer a single entity, such as the Norwegian Public Roads Administration, with overall responsibility for the national and county road network. However, this change also means that the regional authorities are now more responsible for the regional road network, and can therefore have a more overarching responsibility for the overall roads and public transportation systems, including universal design.

Despite the administrative division, the Norwegian Public Roads Administration still holds the social responsibility and regulatory authority for the road sector, and manages regulations and road standards. While it is still unclear how strict the national guidelines for the county road network will be, the regional authorities, through their own road administration, can better adapt road policies and standards to local conditions and political objectives. Moreover, Nye Veier can challenge existing practices for planning and developing national roads. Nonetheless, the Norwegian Public Roads Administration still retains responsibility for national coordination and for expertise in public transport that uses the road system.

5 In the Administrative Reform, responsibility was transferred from government level to the county authorities in several areas, but particularly roads. However, road administration for national and county roads remained with the Norwegian Public Roads Administration through the joint road administration (Sams vegadministrasjon).

There is some concern about whether the new distribution of responsibilities will result in a less uniform service for road users, also in relation to road design, traffic safety, accessibility, and the environment (Directorate of Public Roads, 2020).

The regional authorities have the authority to deviate from road standards and establish their own practices for road management, which could lead to greater regional differences in the county road network than previously. However, it could be argued that differences would exist regardless, because county authorities, as road owners, have different priorities when it comes to investment in the road network, and the topography varies. Nevertheless, providing greater opportunities for local adaptation is one of the reform goals. Regional authorities are the most knowledgeable about local conditions and can thus better assess which solutions are suitable for their region.

The transfer of responsibilities and services to lower tiers of government is often viewed from a democratic perspective. When regional authorities are responsible for the administration of county roads, county committees and councils, such as the Council for the Elderly (*Eldrerådet*)and the Council for Persons with Disabilities (*Rådet for personer med funksjonsnedsettelser*), can have a greater direct influence on strategies, plans and standards than before. The county authority also holds the responsibility for regional development and can more effectively connect roads to other policy areas within its organisation. However, it is likely that the overall coordination between national and county roads will be reduced under the new system, and that future practices will be more differentiated across the road systems.

One aspect of the new system concerns the standards for road and street design. A debate has arisen around what can be considered an 'adequate' standard, particularly in light of regional authorities' previous efforts to find more cost-effective alternatives to the high standards set by the Norwegian Public Roads Administration. Road planners now face greater challenges in developing alternatives and deciding which aspects can be deprioritised in order to achieve solutions that are 'adequate' and enable more roads to be built for the money. Cost considerations have always been a challenge, even when the government was responsible for the county road network, and budget constraints continue to pose a challenge. However, according to data from Statistics Norway, county authorities have increased their county road network budgets since 2010. Upgrading existing infrastructure and facilities to ensure universal accessibility is a costly process and if budgets are tightened, it could lead to deprioritization of universal design upgrades for facilities such as bus stops.

4.2 Changes in the railway sector

The most significant change in the railway sector during Erna Solberg's time as Prime Minister of Norway was the Railway Reform (Ministry of Transport, 2015b), which in 2017 altered the responsibilities in the sector. The aim of the reform was to clarify the distribution of responsibilities and facilitate a more competitive railway system.

The Railway Reform

The reform led to a reorganisation of the former Norwegian National Rail Administration (*Jernbaneverket*) and the national railway company NSB, establishing several new stakeholders and companies.

The Norwegian Railway Directorate was established to assume overarching control of the sector, including strategic planning, infrastructure development, overall coordination of the sector and competitive tendering.

The state-owned enterprise Bane NOR was established to assume responsibility for the national railway infrastructure, including traffic control, operation, maintenance and development of the rail network and train stations.

NSB was transformed into an operating company that no longer owned trains or station properties. The name of the company was changed to Vy.

Norske Tog AS is now responsible for leasing state-owned rolling stock to operating companies that run trains on behalf of central government.

State-owned EnTur AS owns and manages the ticket sales system for trains and is responsible for providing travel planning and basic digital services for public transport throughout Norway (across operating companies).

The development of station areas is a domain where the reform has helped clarify the distribution of responsibilities. Previously, both the Norwegian National Rail Administration (Jernbaneverket) and NSB's subsidiary Rom Eiendom AS had shared responsibility, leading to unclear accountability for developing transport hubs. Now all railway properties are managed by Bane NOR, enabling a more comprehensive development of transport hubs and surrounding properties. This presents an opportunity for a more overarching focus on universal design in and around transport hubs and railway stations. The Norwegian Railway Directorate is responsible for the future development of the railway and procures infrastructure services through agreements with Bane NOR. Government grants are distributed through an agreement for operation and maintenance and an agreement for planning, design and expansion. The establishment of an enterprise reduces central government's ability to directly instruct the management of infrastructure. This can pose a challenge for coordinated planning and requires clear procurement procedures and agreements.

Improved coordination between local train services and other public transport services (bus, boat, ferry, etc.) is another challenge that the reform aimed to resolve and which has implications for universal design. It has previously been challenging for regional authorities to influence changes in train services and to collaborate with NSB on seamless ticketing in regions where local trains are part of the regional public transport system (Krogstad and Aarhaug, 2015). The Oslo region has been an exception when it comes to the coordination of ticket products, but it has been emphasized that the cooperation should be with the contracting authority rather than the operator. As the competitive tendering of railway traffic packages is rolled out, the Norwegian Railway Directorate enters into cooperation agreements with regional authorities on routes, fares and ticketing. The new train operators are obliged to adhere to the agreement and work together to ensure seamless journeys within urban areas. This benefits people with disabilities as well as other passengers. In addition, the establishment of EnTur AS provides a one-stop shop where customers can access route information and buy tickets for trains and other public transport services managed by the county.

'The goal of the Railway Reform was to clarify the distribution of responsibilities related to station areas, route planning, ticketing and information, which are key elements of a trip chain.'

The increased involvement of local and regional authorities in this work was considered crucial to ensuring more seamless transitions within the trip chain. However, it is also important to consolidate infrastructure responsibilities under a single entity. Nevertheless, the reform has led to the emergence of multiple independent stakeholders, who must collaborate in order to optimize the trip chain as a whole. This can pose challenges regarding the comprehensiveness of the transport system, particularly with respect to universal design.

5. How can we ensure universal design of trip chains?

The National Transport Plan 2022–2033 (Ministry of Transport 2021) underscores universal design as a critical principle for achieving the fifth overarching objective, which is to facilitate travel and bolster the competitiveness of business and industry. This necessitates close collaboration among multiple stakeholders to establish efficient, seamless travel experiences and chains over time. Reforms in the transportation sector have modified the allocation of responsibilities and brought about the involvement of new, more autonomous stakeholders. As such, collaboration is vital to realizing universal design across the entire trip chain.

Photo: Ruter As / Redink, Thomas Haugersveen

5.1 Budget constraints

In recent years, significant efforts have been made towards realizing a transport system that is universally designed. Presently, low-floor buses, real-time information, and automated announcements of upcoming stops have become the standard throughout most of Norway. Nonetheless, upgrading infrastructure can be a time-consuming and costly endeavour. Budgetary limitations may pose the most significant obstacle to advancing universal design. This may cause the upgrading of existing infrastructure to become a balancing item – a consideration that is relinquished in budgetary talks in favour of other measures or projects deemed more pressing.

The government has previously introduced various financial support schemes, such as the BRA support scheme for better infrastructure, rolling stock, active logistics improvements (*BRA-ordningen*) (2006-2015), the grant for public transport in rural areas (*KID-ordningen*) (2007-2015) and financial incentives for giving regional authorities access to funds to upgrade public transport infrastructure. If the government wishes to expedite the work on universal design, similar support schemes can once again be established. An evaluation of the BRA support scheme showed that the implemented measures were well-received and made it easier for people with

disabilities to use public transport. An alternative solution is to employ national road funding to upgrade to universal design in areas where it is deemed critical. Such an approach is currently being implemented in cities through urban growth agreements[6], although not yet in the towns. In this regard, the Norwegian Public Roads Administration, which is responsible for overseeing public transportation, can assume an important role in administering any forthcoming financial support schemes.

In light of recent reforms, regional authorities now possess their own road administration departments and can therefore contest expert assessments of what may be deprioritised in order to attain satisfactory solutions whilst making the funds go further.

In the future, there may arise a question concerning the acceptability of alternative solutions that render the trip chain accessible but not necessarily universally designed. Frequently, the challenge lies in the uncertainty of whether an individual can access a mode of transport – as opposed to their capacity to embark it independently or with the help of adapted solutions. The emphasis on solutions that offer accessibility, albeit not necessarily universal design, can spark discussions about the value of such solutions. It is therefore important to stress that a focus on ensuring accessibility should not be employed to bypass universal design solutions where such solutions can be achieved.

5.2 Specialist guides and development

Current legislation includes stringent requirements to ensure that people with disabilities are not discriminated against, either directly or indirectly. This means that the requirement for universal design is statutory in all parts of the trip chain: footways to and from public transport stops as well as the stops themselves, information, ticketing and the design of vehicles. However, legislation on universal design in the transport sector is fragmented and, in some areas, unclear. Laws and regulations are intended to be general and not to stipulate specific solutions. This can lead to various stakeholders adopting disparate practices with regards to designing solutions.

The recent organisational changes in the transport sector have resulted in a rise in the number of stakeholders, including more autonomous stakeholders over which the government does not have the authority to directly instruct. As such, it is important to keep an eye on the development and practices of universal design of trip chains via reporting procedures and guidance. Ultimately, the government has the

6 Urban growth agreements are policy packages where the main objective is to reduce car traffic and increase use of walking, bicycling and public transport, adopted by regional and local entities in the 9 largest urban areas in Norway.

option to tighten legislation if the development is not in line with national objectives. However, specialist guides and national guidelines are more flexible tools for updating knowledge when practices do not align with the objectives.

The Directorate of Publics Roads (a branch of the Norwegian Public Roads Administration) bears the responsibility of setting criteria for the design of roads and streets. Regional public transport departments have established a collaboration, and standards have been devised to streamline the procurement of vehicles and fulfil legal requirements concerning passenger rights.

'Guidelines and standards can be effective tools for establishing uniform solutions that meet legal requirements. However, their tendency to focus on specific disabilities (such as reduced mobility or vision impairment) while overlooking others (such as hearing impairment, cognitive impairment, mental health problems, etc.) is a challenge.

If a wide range of challenges and needs is not taken into account, it can be difficult to achieve universal design for entire trip chains. To establish effective knowledge sharing and uniform guidelines, collaborative platforms must be established where the various stakeholders can contribute to the development of specialist guides for different modes of transport and functionality requirements. This will also benefit passengers as they will no longer have to deal with different systems throughout the country.

All planning requires discretionary assessments. Planners can interpret and assess considerations in different ways, and knowledge of universal design can vary according to their experience and education. Existing topography, such as natural inclines, may also limit the possibility of creating solutions that adhere to universal design standards. Nevertheless, it is important for planners to see the overall picture of the system and how different solutions are interconnected. Road standards apply to the design of new roads, but most upgrades are isolated improvements to existing roads. This sets a high bar for planners' competence and professional judgement.

To ensure effective knowledge sharing, it can be crucial to establish specialised arenas and arrange themed meetings across tiers of government and modes of transport. National competence-building arenas can be useful for discussing existing laws and regulations and solutions. An example of this is the Norwegian Directorate for Children, Youth and Family Affairs' national network – Universal design in regional and local public transport – which aims to enhance the competence of stakeholders in public transport and development as well as contracting authorities, operators and other stakeholders within the trip chain at national, regional and local level. Another useful tool could be a professional competence programme aimed at learning, competence development and competence enhancement. It is also important that a single stakeholder has primary responsibility for gathering positive experiences from various places throughout the country and conducting research and development to generate new knowledge.

5.3 Cooperation

The weakest link in a trip chain determines its overall strength. Because the transport system is complex, responsibility for its various components is shared among different stakeholders. Cooperation is therefore essential for establishing seamless trip chains.

To minimize the likelihood of disruptions in the trip chain, it is essential to discuss this matter during the planning, design and construction stages of a project. The project manager is responsible for establishing cooperation with relevant stakeholders in order to ensure universal design in the relevant and adjacent links in the trip chain. The larger and more complex the project is, the more stakeholders and tiers of government are typically involved. Therefore, effective and robust cooperation among the different stakeholders is key to ensure that universal design is maintained during this phase.

'The weakest link in a trip chain determines its overall strength.'

Research indicates that people with disabilities often encounter obstacles when using public transport when transferring from one stage of their journey to another or from one operator to another. This can result in passengers being unable to complete their journey. If transfers between operators in pre-existing infrastructure are not universally designed to be seamless, it is not always evident how this issue can be addressed or who is accountable.

It is equally important to highlight issues and challenges that arise during the transfer between links in the trip chain and to discuss potential solutions among the relevant stakeholders. This will facilitate the identification of whether this is a recurring issue at multiple sites and may reveal a necessity for uniform solutions.

The work on universal design is broad and spans various sectors. In the transport sector, it can therefore be important to have a national action plan for universal design that is overseen by the transport sector authority.

'The national road safety action plan serves as an example of a plan that has been collaboratively developed by numerous stakeholders and delineates measures and responsibilities. Perhaps this model can be employed for universal design?'

When establishing this type of action plan, it is also necessary to establish a national network that oversees this work and cooperates to generate more knowledge on, and propose solutions for, how to ensure universal design across the entire trip chains. Such a network should strive to produce recommendations on how different forms of collaboration can and should occur to ensure the effective implementation of universal design across stakeholders' areas of responsibility throughout the trip chain.

Regional authorities assume a crucial role in upholding regional coordination concerning universal design work. It is imperative for local and regional stakeholders to coordinate and collaborate at a comprehensive level that enables them to determine which transport hubs and routes should be prioritised and in what sequence, and to ensure implementation. Collaboration networks at the local level can provide stakeholders with a broader and more comprehensive overview of local challenges and of how to contribute to solutions. They can also offer more specific insights and knowledge for particular projects. The networks should also focus on how the different stakeholders can work together to achieve a coherent development of entire trip chains and ensure a comprehensive approach to universal design in the transport sector. Cities often possess pre-existing local networks in the form of urban development and transport partnerships (known as bypakke), but there may also be collaboration networks focusing specifically on universal design.

6. Summary

Restructuring and reforms can destabilize inter-organizational relationships, both formal and informal, as they may require re-establishment. Moreover, stakeholders who have undergone a restructuring process may experience uncertainty regarding their areas of responsibility for a period if this has not been explicitly communicated throughout the entire process. This can render it more challenging to uphold progress and continuity, both for the stakeholders involved in the reforms and for external actors who need to maintain the cooperation with affected individuals and agencies. The result may be a diminished attention on universal design and more problematic follow-up during brief periods.

Nevertheless, the requirements for universal design in areas such as the planning and construction of infrastructure and the procurement of vehicles are clearly stipulated in existing legislation. The current legislation (and the associated regulations) imposes stringent requirements on how society should make the necessary adaptations for people with disabilities. To date, the changes in organisation and areas of responsibility that have been implemented in Norway are unlikely to have any significant adverse impact on the universal design of the transportation system in a long-term perspective. The challenge is due to the fact that the regulatory framework for universal design is dispersed across a series of laws and regulations under different ministries, and this fragmentation sometimes leads to confusion regarding who is accountable for the overall picture (Ministry of Transport, 2020).

Below, we summarise some of our recommendations on how to ensure universal design in the transportation sector within a system of complex laws, rules and responsibilities. Our suggestions are organized into three main categories: Budget constraints, specialist guides and development, and collaboration.

Budget constraints

- To ensure that the upgrading of existing infrastructure is not sidelined in favour of other measures, the establishment of financial support schemes can sustain a continued focus on universal design.
- National road funding can be used to upgrade infrastructure to universal design standards where this is critical.
- Several influential stakeholders in the road sector (county authorities and Nye Veier AS) can contest standards regarding what constitute 'satisfactory' solutions moving forward.

Specialist guides and development

- The growing number of stakeholders, including independent stakeholders, in the transport sector means that it will be important to oversee development and practices within universal design in trip chains.
- Guidelines and standards can be effective tools for establishing uniform solutions that meet statutory requirements, and these should be developed and updated on an ongoing basis.
- Collaborative platforms ought to be established where diverse stakeholders can contribute to the development of, for instance, specialist guides for different modes of transportation and functionality requirements.
- To ensure effective knowledge sharing, specialized arenas can be established to host themed meetings that encompass the tiers of government and modes of transport. Examples of such arenas include national competence-building arenas and a professional competence programme.
- A single stakeholder should assume overall responsibility for gathering positive experiences from different regions and initiate research and development to generate new knowledge.

Collaboration

- The project manager must assume responsibility for establishing cooperation with relevant stakeholders to ensure universal design in the relevant and adjacent links in the trip chain. Typically, large and complex projects involve multiple stakeholders and tiers of government.
- If transfers from one operator to another in already established infrastructure are not seamless in terms of universal design, it is not always clear how such a problem can be resolved or who is actually responsible. A single stakeholder should be responsible for dealing with such problems.
- *A national action plan for universal design in the transport sector can serve as an effective approach for overseeing the various stakeholders' responsibilities and can function as a tool for generating more knowledge on universal design throughout the trip chain*.
- *County authorities can assume responsibility for the regional coordination of universal design work, and/or it can be incorporated into existing local networks that exist through urban development and transport partnerships.*
- A trip chain is only as strong as its weakest link and cooperation is therefore essential for establishing seamless trip chains. *Regardless of the recommendations above, universal design should be well-supported by all stakeholders working on the different components of trip chains*. Universal design has become an increasingly integrated and natural part of the transport sector. However, it is important that competence is enhanced on an ongoing basis and that resources are allocated to following up on objectives, strategies, measures and goal achievement.

7. Further reading

Directorate for Children, Youth and Family Affairs (Bufdir). 2020. ***Universell utforming. Tilstandsanalyse og kunnskapsstatus.***

https://bufdir.no/globalassets/global/nbbf/universell_utforming/universell-utforming---tilstandsanalyse-og-kunnskapsstatus_uu.pdf

This is a review of the status of universal design in Norway as of 2020. The purpose is to describe the status of universal design in Norway and provide a basis for developing policy and measures in this area. Providing a complete overview of the extent of universal design in Norway is challenging due to the lack of systematic measurements of accessibility and universal design. It is also partly due to the wide-ranging scope of universal design and the multitude of domains it encompasses, such as ICT, transport, planning, construction, outdoor spaces, products and services.

Krogstad, J.R., Phillips, R.O., Berge, S.H. 2019. ***Kollektivtransport for alle: Bussjåførenes rolle.*** **TØI rapport 1683/2019.**

https://www.toi.no/getfile.php?mmfileid=50230

The report uses document reviews, interviews and a survey to gain insight into the factors that impact on how bus drivers deliver service to passengers with different needs.

Krogstad, J.R. 2015. ***Fylkeskommunenes arbeid med universell utforming i kollektivtransporten.*** **TØI rapport 1456/2015.**

https://www.toi.no/getfile.php?mmfileid=41624

The report summarises the county authorities' work on universal design in public transport and assesses the greatest challenges for the work going forward. The report provides an introduction to the county authorities' responsibilities in 2015, which are still largely applicable.

Lerdahl, E. 2015. ***Slagkraftige møter - større engasjement og bedre resultater.*** **Fagbokforlaget**

This is the book for anyone who wants to create engaging and productive meetings in which participants are actively involved and visible results are achieved. The book describes simple methods that you can use to create dynamics, focus and direction in meetings. The book covers everything from daily update meetings to large all-day meetings. You are introduced to numerous methods and tips for planning, chairing and conducting meetings. These can be easily incorporated into your working day.

Lerdahl, E. 2007. ***Slagkraft - Håndbok i ideutvikling. Gyldendal akademisk***

This book presents various methods for how individuals or groups can work as efficiently and targeted as possible with idea development. Here you will find methods for every stage of the idea development process – from identifying needs, exploring and developing new ideas, refining and evaluating ideas, to realising and implementing them. The idea development methods are presented as practical examples, using a variety of sketches and images.

Farner, A. 2008. ***Verksted som verktøy - å planlegge og lede workshops.*** **Kommuneforlaget**.

The book explains how workshops can be used as a working method in planning and development work. It describes how workshops can be a process-oriented working method that fosters interaction, participation and innovation. The book links workshops as a working method to planning theory and principles of communication and collaboration. It also addresses the design of workshops for various purposes and specific techniques for implementation, and provides examples from previous workshops.

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6

Effects of universal design: quality of life, demand and economic benefit

NILS FEARNLEY, KNUT VEISTEN AND ANJA FLETEN NIELSEN

The aim of this article is to deepen the understanding of the various effects that universal design can have, including the utility value of universal design in an economic perspective. Universal design is beneficial for everyone who travels and can enhance their quality of life and increase their participation in society, but it is difficult to identify and measure such gains in a demand analysis. This article explains why. Passenger benefit can, nevertheless, be measured in terms of their willingness to pay, and the article demonstrates how this has been done in recent studies. Once we understand the utility value of universal design measures to passengers, the overall value to society can be calculated relatively easily in a cost-benefit analysis using established tools.

Nils Fearnley

Nils Fearnley is a transport economist and senior researcher at the Institute of Transport Economics' Markets and Governance group. Since 2009, he has been working on universal design and public transport through a number of projects for the Norwegian Public Roads Administration, the Norwegian Directorate for Children, Youth and Family Affairs (Bufdir) and its predecessor, Deltasenteret. Fearnley has a particular focus on demand effects, preferences and socioeconomic analysis in relation to universal design.

Knut Veisten

Knut Veisten is an economist who graduated from the University of Oslo and the former Agricultural University of Norway. As a researcher at the Institute of Transport Economics' Department for Mobility, he has worked on the valuation of public goods, including the valuation of walking/cycling and measures for universal design in public transport.

Anja Fleten Nielsen

Anja Nielsen is a health geographer at the Norwegian University of Science and Technology (NTNU), Trondheim. She has been working in the field of universal design and transport systems for six years, focusing on how people with psychosocial disabilities experience transport systems.

1. Introduction

1.1 Universal design

In this article, we apply a definition of universal design as defined by Øksenholt and Fearnley (2022; Article 1 in this collection of articles) and the Ministry of Children and Equality (2017) Section 17:

'Universal design means designing or accommodating the main solution with respect to the physical conditions, including information and communications technology (ICT), such that the general functions of the undertaking can be used by as many people as possible, regardless of disability'[1].

In universal design, as many people as possible must be able to use the built environment, as it is, regardless of age, disability, size, skills, language, culture, etc. Added elements, such as ramps for wheelchair users, are not considered universal design under this definition because they are not part of the original design of the infrastructure. Such added elements are used if the principal infrastructure design fails to eliminate the need for the ramp. The ramp aids accessibility when the main solution is inadequate but is not classified as a universal design measure.

In transport, universal design is particularly relevant for public transport and walking. Public transport is a common good that should be accessible for everyone, and therefore all passengers have general protection as outlined in, for example, the EU Regulation (EEA, 2011) on the rights of passengers in bus and coach transport, Article 9 Right to transport:

'Carriers, travel agents and tour operators shall not refuse to accept a reservation from, to issue or otherwise provide a ticket to, or to take on board, a person on the grounds of disability or of reduced mobility.

Reservations and tickets shall be offered to disabled persons and persons with reduced mobility at no additional cost.'

1 This definition, using 'as many as possible', does not imply that universal design should cater for everyone's needs. For instance, the UN (2007) definition is more comprehensive and includes products, programmes, environments and services, in addition to physical conditions and ICT-related aspects. The UN definition also uses the word 'all' instead of 'as many as possible', and disabilities are only mentioned in the context that 'Universal design shall not exclude assistive devices for particular groups of persons with disabilities where this is needed.'.

Walking is the only type of transport that is entirely free, and it is therefore financially accessible to everyone. This is why the provision of footways and outdoor areas is crucial for participation in society. Furthermore, users of local public transport have lower incomes on average than the rest of the population (Fearnley, 2006; Fearnley and Aarhaug, 2019). Table 4 shows lower incomes and car ownership among people with disabilities. This article will therefore focus on public transport and walking.

There is no precise definition of where the boundary lies between universal design and other quality improvement measures because universal design is about making services accessible to as many people as possible. In doing so, the utility of universal design is not limited to people with disabilities:

'Per definition, universal design benefit 'as many as possible'.

One such example is low-entry buses. Step-free boarding and alighting is necessary for wheelchair users, but it improves quality for everyone. It also expedites the boarding and alighting processes by saving time and reducing delays, which benefits all passengers, including those already on board, as well as the bus company. By the same token, intuitive and easy-to-read information is necessary for some and enhances the quality for all.

1.2 How many people does this apply to?

Data from the Norwegian national travel survey 2018/19 (Grue et al., 2021) shows that around one in ten people have physical impairments that restrict their ability to use different modes of transport or move around outdoors. This proportion is highest among women (13%, compared to 7% for men) and in the older age groups (Figure 1). The most common issue reported is difficulty walking. Three per cent report problems using public transport.

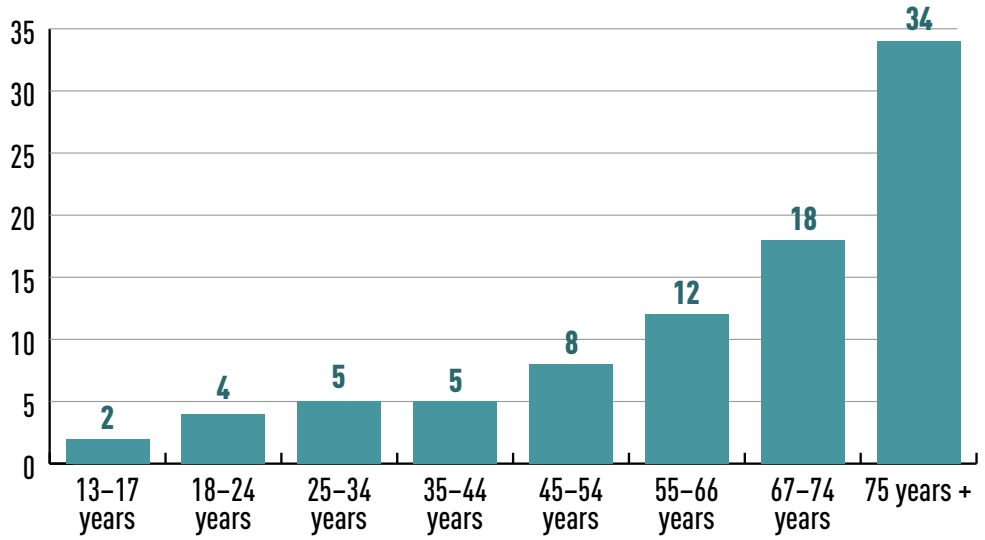

Figure 1: Percentage with mobility issues by age group. RVU 2018/19. Percentage and 95% confidence interval. Source: Grue et al. (2021) Figure 3.4.

Veisten et al. (2020) looked at a wider variety of issues related to using public transport than the Norwegian national travel survey 2018/19. The response alternatives in Veisten et al. included a mix of disabilities and more situation-specific problems, such as carrying luggage and non-physical problems such as cognitive and mental health issues. In this approach, a much larger proportion, i.e. about two out of ten, reported having problems using public transport (Table 1).

Table 1: Reported problems using public transport (N=2599) in response to the question 'Do any of the following make it difficult for you to use public transport?'. Source: Veisten et al. (2020) Table 3.10.

PROBLEM	PERCENTAGE
Impaired vision	1,3%
Asthma and allergies	2,9%
Impaired hearing	0,9%
Mental health issues	2,7%
Trouble walking or mobility impairment	2,7%
Pushing a pram or carrying heavy luggage	4,7%
Problems understanding timetables, route maps etc.	1,3%
Other	4,1%
None of the above	80,9%
Don't know/don't want to answer	2,2%

1.3 Measures and status

In 2009, Fearnley et al. conducted a study that was to have interesting implications for further work on universal design in public transport. Despite the fact that universal design is about accessibility for 'all' and 'as many as possible', the prevailing view was that universal design measures were primarily for people with special needs, such as wheelchair users. In Fearnley et al. (2009), public transport users in Oslo, Drammen and Kristiansand were asked about their perceptions of universal design measures in public transport. The results are presented in Figure 2.

'Despite some variation, the majority responded that they perceived the measures as quality improvements and not specifically targeted towards disabilities.'

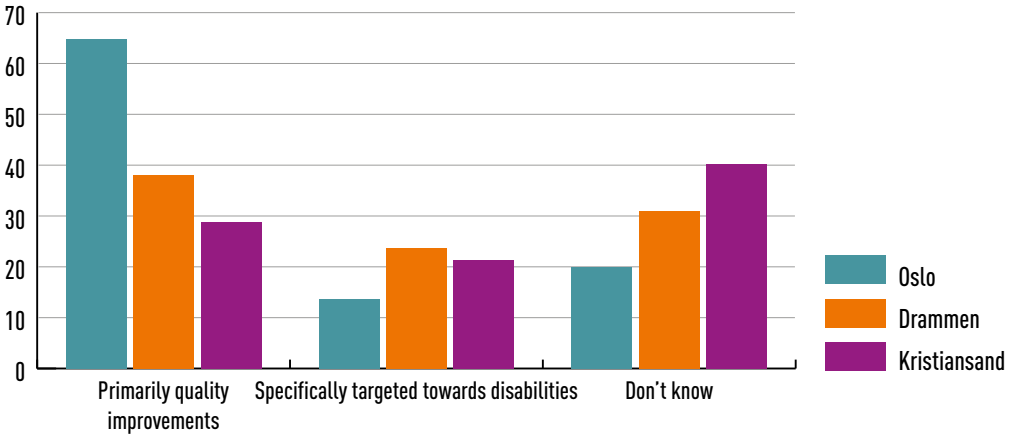

Figure 2: Breakdown of passengers' perceptions of universal design measures in public transport. Percentage. Source: Fearnley et al., 2009, Figure 4.7.

Just over ten years later, Veisten et al. (2020) carried out a similar exercise. First, they mapped whether accessibility measures make it easier to use public transport. Most general interventions relating to bus and tram stops (Figure 3) and most on-board measures (Figure 4) contribute to this.

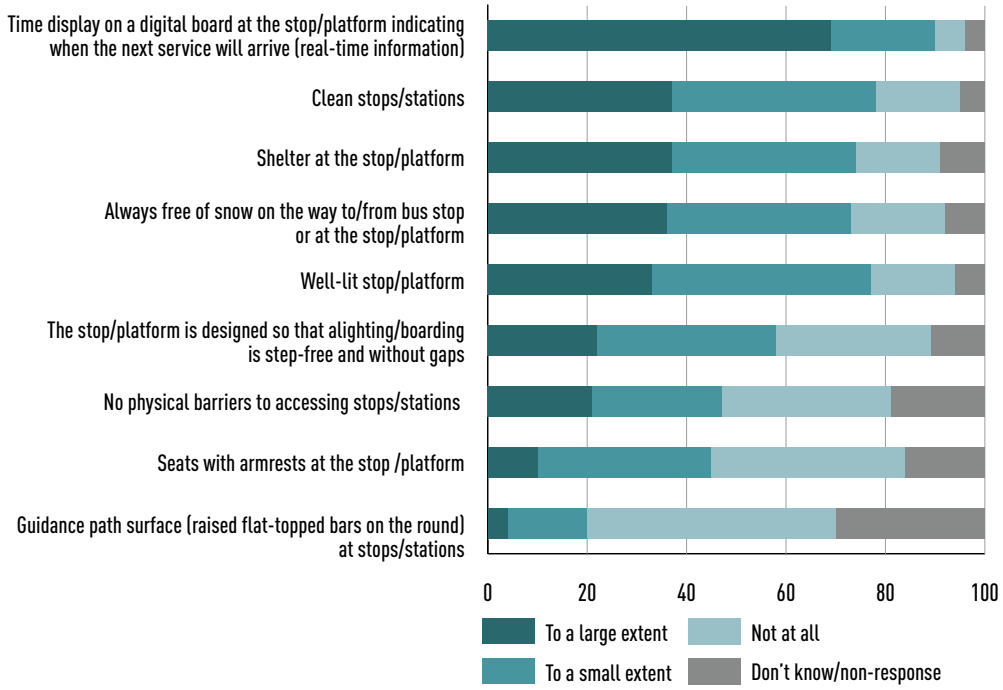

Figure 3: To what extent do you think that the following interventions at stops/stations make it easier for you to use public transport? (N=2599). Source: Veisten et al. 2020 Table 5.10. 'Don't know' and non-responses are not included.

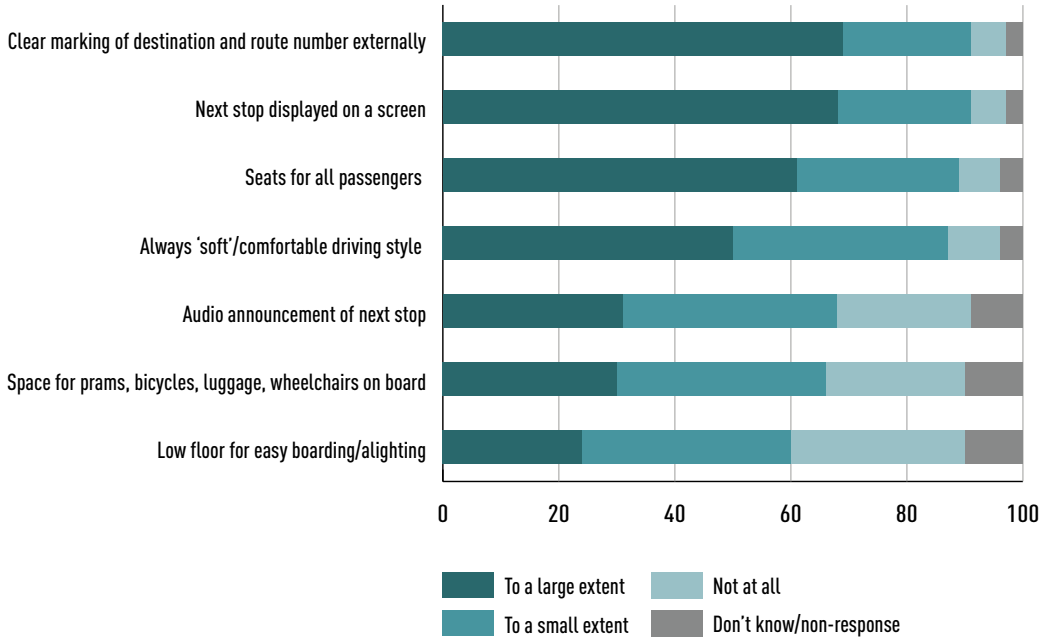

Figure 4: To what extent do vehicle/on-board measures simplify the use of public transport for you? (N=2599). Source: Veisten et al. (2020) Table 5.11. 'Don't know' and non-responses are not included.

Veisten et al. (2020) also asked a similar question regarding whether the measures mentioned were perceived as general quality improvements or as targeted towards specific user groups (Table 2).

Table 2: Are the measures mentioned general quality improvements or targeted towards specific user groups? (N=2599). Source: Veisten et al. (2020) Table 5.13.

	Primarily general quality improvements in public transport services	Targeted towards people with disabilities and passengers with special needs	Both	Don't know
General quality improvements or for special needs?	35%	18%	39%	8%

Almost 40% stated that they consider the measures to be both general quality improvements and targeted towards specific user groups. One-third regarded the measures as general quality improvements, while just under 20% considered them to be targeted towards specific user groups.

These findings have paved the way for innovative approaches to universal design:

> Universal design does not have to be merely a minimum requirement for new-builds and upgrades. It can also be viewed as a tool to make public transport more appealing for everyone. Universal design measures can also, therefore, compete for investment and operating budgets on an equal footing with other public transport initiatives, such as improved service frequency.

This marked the beginning of valuation surveys that estimate the utility of universal design measures in public transport to passengers, measured in terms of willingness to pay. These valuations can in turn be used in cost-benefit analyses to calculate economic efficiency and to prioritise competing investment projects. We will take a closer look at this later in this chapter, but first we will demonstrate how the benefit of universal design is not limited to what can be measured and quantified.

2. Effects on quality of life

Freedom of mobility is essential for people to be able to work and study outside their own home and participate in various activities. Mobility is needed to engage in social activities with family and friends, participate in clubs, choirs, sports etc., as well as to carry out activities independently. Having the opportunity to travel is, *in itself*, an important aspect of quality of life because it allows people to be independent, reduces their reliance on others in their daily life, and provides greater flexibility in choosing when to participate in activities that people need and want to be a part of:

'Without the opportunity to travel, life would be quite dull. Isolating in every way. Anything is better than sitting at home staring at the wall' (in relation to people with a psychosocial disability having accessible public transport (Nielsen and Skollerud, 2018)

The UN defines 'freedom of mobility' as a human right, and universal design is therefore imperative for avoiding discrimination against individual groups and ensuring that everyone has equal opportunities to participate in society. An absence of freedom of mobility not only affects the individual but also has a bearing on society as a whole, as more people become dependent on disability benefit and the positive contribution they could have made is lost. In addition, the positive contribution of people's participation in society is lost.

A study by Hjorthol et al. (2013) gives an overview of aspects of walking that are not necessarily quantifiable in economic terms (Figure 5). Transport is essential for quality of life and for a social and active life (Table 3). Women place a higher value on these factors than men (Hjorthol, 2013; 2011).

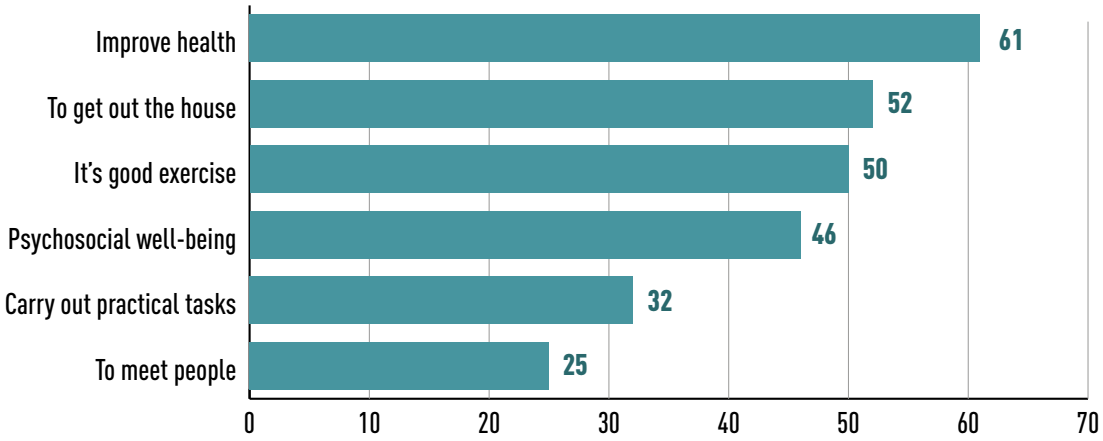

Figure 5: The main reasons for going for a walk. The percentage who answered 'Very important'. Kristiansand, 2012. Hjorthol et al., 2013.

Table 3 The percentage who say that the various statements apply, by gender. Norway 2010. Percentage. N=4020. Source: Hjorthol et al., 2011 Table 6.1.

	Transport is necessary for me to have a social and active life	Knowing that transport is available or that I can get out when I need to is essential for my quality of life	I will feel old the day I can't go out on my own
All	*52*	*68*	*80*
Female	55	73	80
Male	49	63	81

Social networks and participation are crucial for both physical and mental health. Social isolation and loneliness – both perceived and actual isolation – are associated with premature mortality (Holt-Lundstad et al., 2015; House et al., 1988). In contrast, participation in social networks has a range of positive effects on health and health behaviour:

- Slower development of functional impairments, as social networks have a protective effect on the development of functional impairments[2] in older adults (Escobar-Bravo et al., 2011)
- Increased use of mental health services by people who are suicidal, which reduces the risk of suicide (Youn et al., 2020)
- Better mental health (Takagi et al., 2013; Kawachi & Berkman, 2001)
- Slowed development of dementia (Wang et al., 2002; Marseglia et al., 2019)
- Better self-reported health (Sirven & Debrand, 2008; Lee et al., 2008; Giles 2004)
- You can be a resource for others and give more back to society, such as helping sick friends or looking after grandchildren (Nordbakke et al., 2020)

2 Functional impairment is measured here in terms of ADL (activities of daily living) and IADL (instrumental activities of daily living) – the ability to take care of oneself – eating, personal hygiene, transportation etc.

Social participation is correlated with both quality of life and self-perceived health (Gilmour, 2012). Studies of older adults show that social participation can have a protective effect against loneliness associated with low wealth (Niedzwiedz et al., 2016) and that participation in organisations reduces mortality for men (Wilkins, 2003).

Being able to access transport is an essential prerequisite for participation. A longitudinal study in Ireland (Donoghue et al., 2019) of people over the age of 50 found that those who depend on others for transport have a lower quality of life, poorer mental health and less frequent participation in social activities. Those who had reduced their own driving in the past five years also had higher scores for depression and loneliness (ibid.).

'Those who depend on others for transport have a lower quality of life, poorer mental health and less frequent participation in social activities. Those who had reduced their own driving in the past five years also had higher scores for depression and loneliness.'

Another study shows that the reasons for non-participation in activities among older adults are linked to transport in 4% of cases for men and 11% for women (Gilmour, 2012). A quantitative study by Nordbakke (2016) showed that people with physical disabilities had fewer of their travel needs met than the general population. There are no corresponding studies for people with psychosocial disabilities, but research on travel behaviour indicates that this group also travels less frequently than others (Mackett, 2017). The Mental Health Action Group (2011) concluded that limited access to public transport leads to isolation and the exacerbation of symptoms, while good access is important for positive mental health. A smaller, qualitative study (Nielsen and Skollerud, 2018) also found that being able to travel was crucial for the informants' mental well-being.

Data collected in Veisten et al. (2020) shows that a much higher proportion of households with people who find it difficult to use public transport because of physical or mental health challenges have no access to a car (Table 4). In other words:

'people with physical and mental health challenges are more reliant on a universally designed public transport system for participating in activities outside their home. They also have significantly lower personal and household incomes than those without such challenges.'

Table 4: Car ownership and income among people with and without physical/mental health challenges related to public transport. Source: Data in Veisten et al. (2020)

	Physical/mental health challenge		
	No	Yes	No. of respondents (N)
Household has car	68%	56%	2 599
Personal income	533 920	390 700	2 357
Household income	1 026 310	800 750	1 816

3. Demand[3]

Unfortunately, the research literature does not have clear answers as to whether or to what extent universal design affects the demand for public transport.

Within public transport analyses, a distinction is made between hard and soft quality factors. The division between them is not exact but must be interpreted based on purpose and context.

The *hard quality factors* are normally those that are easy to measure and quantify. They often form part of transport models and are considered to play a key role in demand, passenger costs, perceived travel burden and operator costs. Hard quality factors include ticket price, walking time, waiting time, travel time, service frequency (or headaway), and interchanges.

Soft quality factors meanwhile, encompass all other quality improvement measures, including comfort, low-entry and step-free boarding, availability of seats, travel and route information, facilities on-board and at stops, safety, cleanliness, driving style, etc. Many of the soft quality factors will help improve the universal design of public transport.

Compared to hard quality factors, the soft factors generally have a more limited effect on demand. This complicates the measuring of demand effects as these can easily be overshadowed by other factors that have a greater impact on passenger trends (such as unemployment, petrol prices and land use). Moreover, quality improvements are difficult to measure and quantify on a meaningful scale. As a result, both the improvements and their demand effects are difficult to map and measure.

3 The content of this section presents the main findings and text from Fearnley et al. (2015).

The most commonly reported demand effects of quality improvement measures are therefore based on less scientific approaches. For example, there are many anecdotal descriptions in industry journals along the lines of 'more accessible buses led to growth in passenger numbers'. Typically, they incorrectly attribute the entire change in demand after implementation of a quality improvement measure to this one measure. Other studies are based on self-reported changes in behaviour and attribute the entire demand effect to quality improvement measures without attempting to correct for effects of other factors that may be involved. Caution must therefore be exercised when considering such claims. Against this backdrop, Fearnley et al., (2009) found that about half of the respondents say they travel more often as a result of universal design measures in public transport.[4]

The most common alternative method for evaluating the demand effects of universal design is to assess passengers' willingness to pay (see the next chapter), so-called implicit demand calculations. The method is relatively simple:

If the willingness to pay for a universal design measure matches the willingness to pay for X minutes of travel time savings, it is assumed that the demand effect of the measure matches the demand effect of the same X minutes of reduced travel time. Thus, known demand effects of 'hard' quality factors (travel time in this instance) are leveraged and applied to 'soft' quality factors.

This method has numerous weaknesses and should be considered a 'last resort' in the absence of more insight (Fearnley et al., 2015). Nonetheless, Currie and Wallis (2008) synthesised a large number of studies and converted quality improvements into travel time savings and then into demand effects (patronage impacts).

Table 5 is from their study and gives an indication of the envisaged magnitude of the demand effects. Driver skills have a strong effect (0.68-1.02% demand effect), as does CCTV (video surveillance; 1.19%) and air conditioning (1.70%).

4 The measures include: clear signage; space for prams, bicycles and wheelchairs; low floor; stop announcements; as well as stops announced on the on-board display screen.

Table 5: Demand effects of soft quality factors based on travel time equivalents. Source: Currie and Wallis (2008, Table 2).

'Soft' bus improvement		Valuation[a] (in-vehicle time minutes)	Notes	Estimated patronage impact (%)[b]
Boarding	No step	0.1	Difference between two and no steps	0.17[c]
	No pass show	0.1	Two stream boarding, no show pass vs single file past driver	0.17
Driver	Attitude	0.4	Very polite helpful cheerful well presented vs businesslike and not very helpful	0.68
	Ride	0.6	Very smooth compared to jerky	1.02
Cleanliness	Litter	0.4	No litter compared to lots of litter	0.68
	Windows	0.3	Clean windows, no etchings compared with dirty windows and etchings	0.51
	Graffiti	0.2	No graffiti compared with lots	0.34
	Exterior	0.1	Completely very clean compared to some very dirty areas	0.17
	Interior	0.3		0.51
Facilities	Clock	0.1	Clearly visible digital clock with correct time vs no clock	0.17
	CCTV	0.7	CCTV, recorded, visible to driver plus driver panic alarm compared to no CCTV	1.19
Information	External	0.2	Large route number and destination sign front, side and rear plus line diagram on side vs small signs	0.34
	Interior	0.2	Easy to read route no. and diagram compared to none	0.34
	Info of next stop	0.2	Electronic next stop sign and announcements vs no information	0.34
Seating	Type/layout	0.1	Individual shaped seats with headrests all facing forward vs basic double bench some backwards	0.17
	Tip-up	0.1	Tip up sets in standing/wheelchair area compared with all standing area in central aisle	0.17
Comfort	Legroom	0.2	Space for small luggage vs restricted legroom and no space for small luggage	0.34
	Ventilation	0.1	Push open windows giving more ventilation vs slide opening windows	0.17
		1.0	Air conditioning	1.70

a Based on Australian Transport Council, 2006.

b Assumes a 20 min bus journey with 5 min access/egress walk, 5 min wait, a $1.50 fare and a value of time of $Aust 10.00/h (2006). This makes a weighted generalised cost of 59 min. Forecasts are made by applying a generalised cost elasticity of –1.0 to the change each soft factor has on this base generalised time. These assumptions are based on (Booz Allen Hamilton, 2000b, Australian Transport Council, 2006).

c The 0.17% impact of a 'no step' bus is small compared to estimates of the impact of low floor vehicles (Balcombe et al, 2004; 5% and TAS Partnership, 2002; 3–9%). We conclude that this is a 'low' estimate or that it concerns only the implementation of a step and not the provision of an entirely new low floor vehicle.

In summary, the knowledge about how universal design affects the demand for public transport is almost non-existent or, at best, poorly substantiated. This is partly because the demand effects are so small that they are difficult to distinguish from natural demand fluctuations and the effects of external factors such as petrol prices and employment levels. It is also partly because there have been few scientific studies of the correlations.

4. Willingness to pay

4.1 Measures to increase universal design can reduce travel inconvenience

Although it is difficult to calculate the demand effects of universal design in public transport, it is possible to measure the utility of such improvements to passengers.

People are willing to pay for transport because it enables them to engage in activities (such as work, school, shopping, leisure activities, visiting friends, etc.). If part of the inconvenience of travelling is reduced or eliminated, the expectation is that people will be more satisfied with public transport and may even want to travel more.

In the information box below, a simplified example is given of how a trade-off between two scenarios can provide information about willingness to pay – travel time savings in this context.

Box 1: Deducing the value of time based on a trade-off

WHAT DO YOU CHOOSE?

Journey A	**Journey B**
• Price NOK 10	• Price NOK 14
• 20 minutes	• 15 minutes
○	◉

A person who prefers Journey B makes a trade-off that suggests a 5-minute time saving is worth paying NOK 4 more. Thus, for that person the time saving is worth at least NOK 0.80 per minute.

Willingness to pay does not entail passengers actually paying more to achieve better quality or avoid poorer quality. It is an expression of how much the passenger thinks a trade-off between various travel factors is worth.

When people state their willingness to pay for universal design measures, it indicates that the travel inconvenience will be reduced if the measure is implemented. The time spent travelling and waiting/transferring may also be considered less of an inconvenience with the measure than without it.

Some people will want an improvement to be implemented throughout the entire journey from start to finish, so that all public transport stops and vehicles, and the entire access road etc. have sufficient accessibility. Improvements to only one part of the journey chain (see Øksenholt and Krogstad, 2022) may not be enough for these passengers to perceive increased utility for the entire journey.

Willingness to pay is linked to a person's ability to pay. Their preferences for specific goods and services guide their willingness to pay, but their ability to pay also matters. For many goods, there will be a positive correlation between income and willingness to pay. As shown in the previous chapter, people with disabilities have relatively lower incomes. They may be willing to pay more for (the utility derived from) specific universal design measures, as documented in Fearnley et al. (2009), but the income distribution has a moderating effect.

4.2 Estimated valuations of universal design measures

In the autumn of 2018 and summer of 2019, surveys were conducted of public transport passengers in Oslo, Trondheim and other parts of Norway. The respondents considered various (levels of) measures related to accessibility and universal design. The valuations were derived from so-called choice experiments, where respondents chose between sets of two alternative public transport journeys with different levels of quality, as well as different travel/waiting times and in some cases different ticket prices – similar to the example in Box 1 (see Table 6).

Table 6: Example of a choice presented in the survey on quality factors in public transport.

QUALITY	ALTERNATIVE A	ALTERNATIVE B
Shelter at the stop	No roof over the stop	Small shelter – roof and back wall
Seating at the stop	Large bench with armrests	No seating
Cleanliness (washed/litter removed) at the stop	Often dirty/with litter	Usually clean
Maintenance of stop	Damaged/worn out items are repaired/replaced within one week	Damaged/worn out items are repaired/replaced, but it takes a few weeks
Waiting time at the stop	7 minutes	13 minutes
Ticket price	NOK 30	NOK 24

Each respondent was given six such pairwise choices, with slightly different descriptions of the various qualities, different waiting times and different ticket prices. The choices of alternatives enable estimating the trade-offs between the components (attributes) in the choice experiment. The trade-off between a change in the level of one quality factor and a change in ticket price gives the monetary value of the change in the quality factor.

For further details, refer to Veisten et al. (2020). Figure 6 is a summary of some of the valuation estimates.

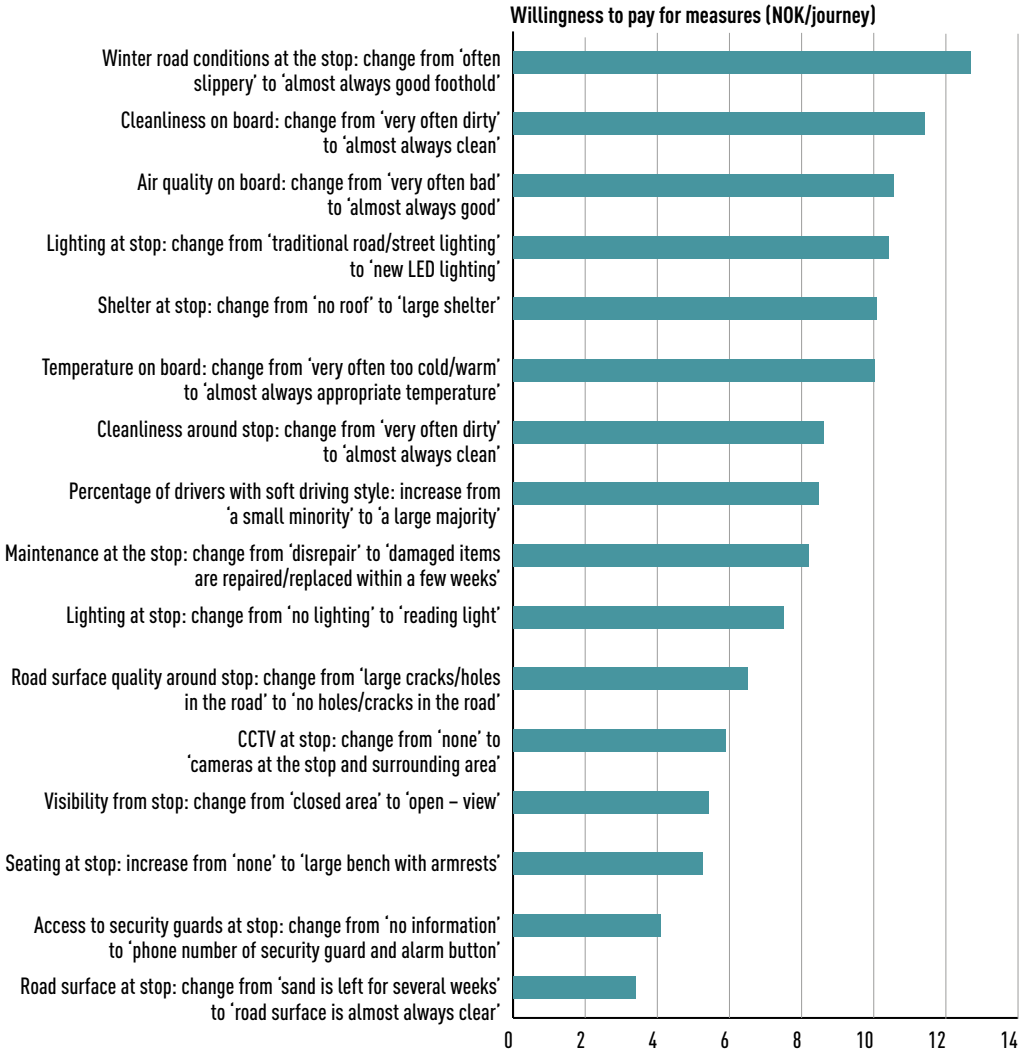

Figure 6: Extra willingness to pay per journey for comfort and universal design measures on board and at the stop/station – from the lowest quality level to the highest level (of three specified quality levels).

Most of the valued measures/quality factors in Figure 6 are physical installations or technologies.

'Measures on board achieved a consistently high willingness to pay.'

Measures on board achieved a consistently high willingness to pay. There are general standards for the temperature on board public transport vehicles (adjusted for seasonal/day-night variations, i.e. implicitly in line with passengers' clothing). Most people would probably prefer that the temperature on board is not 'very high' on cold days and not 'very low' on hot days. Air quality and cleanliness on board also have a relatively high value. On public transport, the functionality of a vehicle can depend on the driver operating it as intended. 'Soft driving style' was specified under driver quality, which also achieved a high willingness to pay.

Shelter in waiting areas (stops/stations), and cleanliness/maintenance of these areas are relatively highly valued by public transport passengers. Bench seating in waiting areas can be more crucial for certain groups.

The level of safety and security measures in waiting areas is also more crucial for some groups than others. Both increased visibility from the stop and CCTV at/around stops/stations obtained moderately high values. Good lighting at stops may or may not be related to security, but it was relatively highly valued.

For the information measures at stops/stations, the valuation estimates were somewhat lower, but it was apparent that visible real-time information was relatively highly valued. For some passengers, having more access to information both before and during the journey may be more crucial.

'In terms of the conditions to/from stops/stations, it was reduced slipperiness that was most valued.'

In terms of the conditions to/from stops/stations, it was reduced slipperiness that was most valued. This is not particularly surprising given the mobility limitations and hazards that icy roads cause for many people. Veisten et al. (2019) calculated that halving the scope of slippery winter roads in Oslo would reduce the annual number of pedestrian falls resulting in injuries by roughly 20%. Lighting on the roads to/from stops is also valued relatively highly. The estimates for improved road maintenance were also relatively high. The willingness to pay for faster removal of gravel/sand from the road indicates that leaving it on the road for a while is not critical for many passengers.

Veisten et al. (2020) point out that estimated willingness to pay obtained via questionnaires may be subject to hypothetical exaggeration as there are no direct consequences for people choosing more expensive alternatives with higher comfort levels in the pairwise choices. Nevertheless, it is possible that respondents believed that their answers could have an impact and might influence the decision-makers. If this is the case, respondents might have thought that choosing more expensive alternatives could lead to measures being implemented, even if it meant higher ticket prices.

It will also generally be the case that the implementation of one measure could affect the willingness to pay for another. For example, an individual's budget constraints will reduce their willingness to pay for new measures, given that they have to pay higher ticket prices for each new measure. None of the respondents gave a valuation for all of the measures; they chose between paired alternatives in two rounds, each consisting of four measures. The valuations can be described as follows: the estimated willingness to pay for a measure is valid if this measure is among the first measures to be implemented. For subsequent measures, it is expected that the willingness to pay will be lower than what is shown in Figure 6.

5. Economic efficiency

Economic efficiency is a key part of the decision-making basis for major investments, particularly for investment projects in the National Transport Plan (NTP; Ministry of Transport, 2021). Economic efficiency is calculated in a cost-benefit analysis, which entails quantifying and synthesising all the effects of a project – benefits and costs – and weighing these up against the budgeted cost. In simple terms, we can say that if the benefits outweigh the disadvantages and costs, the measure improves social welfare.

In this context, utility (or benefit) refers to factors such as reduced travel times, smaller queues/less congestion and reduced risk of accidents. The willingness of passengers to pay for universal design measures, as documented above, is a utility factor that can be included in a cost-benefit analysis.

'In this context, utility (or benefit) refers to factors such as reduced travel times, smaller queues/less congestion and reduced risk of accidents.'

In concrete terms, this means, for example, that upgrading a stop from no seating to large benches with armrests gives a passenger benefit of NOK 5.25 per passenger (see Figure 6). If 2,000 passengers use this stop every year, the annual passenger benefit is NOK 10,500. Any disadvantages for others (which in practice is zero) are deducted from this amount. Furthermore, the proposed bench will have a lifespan of several years. Therefore, future years' benefit and potential future disadvantages must be added together to calculate a net benefit in today's currency (present value of benefit). The cost will consist of an investment cost and any annual maintenance costs.

If the net benefit exceeds the budgeted cost and the tax cost,[5] the measure is considered to improve social welfare.

This example is a simplified description of calculations involved in cost-benefit analyses. For further details, see the manuals from the Norwegian Public Roads Administration (2021) Impact assessments. Manual V712 and the Norwegian Railway Directorate Guide to socioeconomic analyses in the railway sector (2018) (both in Norwegian only).

The benefit-cost ratio is the most suitable way of ranking and prioritising competing projects. This ratio shows the net benefit of a measure for each budgeted krone (Norwegian currency) it costs. If the ratio is positive, the measure is viable. A benefit-cost ratio of 0.3 means that society gains NOK 0.30 for every krone spent on the measure, in addition to the money invested. The project with the best benefit-cost ratio should, all else being equal, be given the highest priority.

Based on the aforementioned key finding that universal design measures in public transport are considered a quality improvement for everyone, as well as the estimate of passengers' willingness to pay for such measures, the Institute of Transport Economics has developed several simplified calculation tools for cost-benefit analyses that are well-suited for universal design measures. The most important tools in this context are as follows:

The cost-benefit tool for smaller public transport measures at stops and in vehicles. This includes shelters, seating at stops, accessible passenger information, lighting, snow and ice removal, etc.

Cost-benefit calculation tool for the operation and maintenance of pedestrian and bicycle facilities, including measures related to lighting, road surface standards, winter operation and cleanliness.

These online tools make it very easy to perform cost-benefit analyses. Typically, as in the example of the bench at a stop, it is only information about the costs and the number of users that is needed per year. The tool takes care of the rest:

- It calculates user benefit,
- benefits/disadvantages to others, and
- benefit/cost for operators and for society over the analysis period (which is currently set at 40 years).
- The tool also calculates costs and taxes over the analysis period.

The net present value of the measure is the sum of benefits minus the sum of disadvantages and costs. If the net present value is positive, the measure improves social welfare.

5 The tax cost is often referred to as the shadow price of public funds. This represents society's efficiency loss associated with financing projects through taxation and is routinely set at 20%. (Thus, it is not the actual expenditure but rather the societal 'cost' (efficiency loss) incurred when raising funds through taxes to cover the expenditure.) If the proposed bench costs NOK 5,000 and is financed from public budgets, the tax cost at 20% will amount to NOK 1,000, which is added to the budgeted cost.

When it is not possible to access all the figures required for using these tools, there is a handy feature that helps with this. Figure 7 is a screenshot of this feature.

Imagine that you are thinking about installing seating at a stop and have a good idea of the costs (which are input as NOK 10,000 for installation and NOK 1,000 for annual operating and maintenance), but you are uncertain about the number of passengers who will benefit from the measure. The graph helps you with this. In this example, the graph shows that the measure is welfare improving if the annual number of users of the stop exceeds approximately 550 – or an average of 1.5 passengers per day. Even with minimal knowledge about the stop, in most cases, you can quickly assess whether the usage of the stop makes the measure viable. Corresponding graphs can be created for the other input data, such as installation costs and annual operating and maintenance costs.

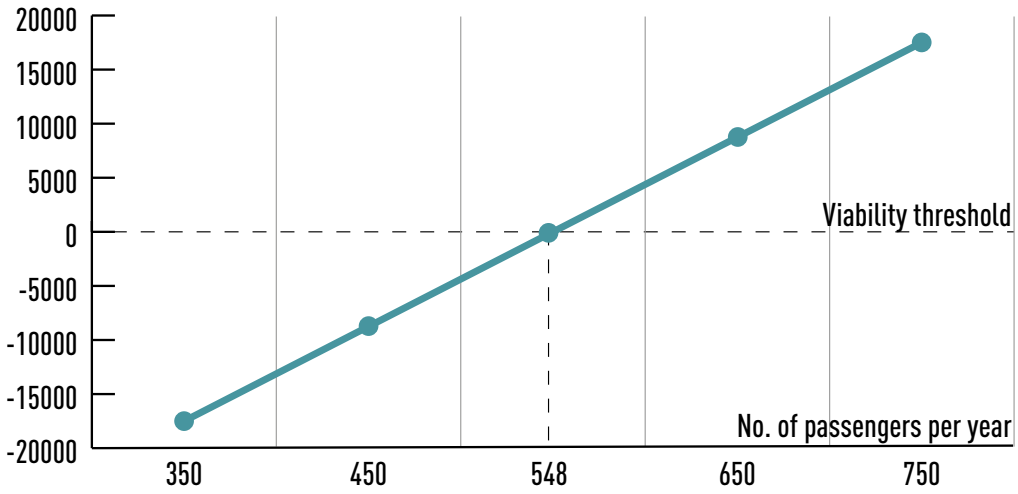

Figure 7: Screenshot of the tool for calculating social welfare in public transport. The graph shows how the benefit of the measure depends on a selected input variable – in this case the number of passengers per year.

Hagen and Odeck (2007), and subsequently Odeck et al. (2010), demonstrated that this type of calculation tool can be used to document the overall value to society of universal design measures in public transport. As in the example of seating at a stop, a vast number of bus stops will have usage patterns that suggest a high value to society. The benefit-cost ratio can easily reach double figures, meaning that society gains more than ten times the value of what the measure costs.

As mentioned at the beginning of this section, projects in the National Transport Plan (NTP) are subject to cost-benefit analysis. In the current NTP (Samferdselsdepartementet, 2021 Table 10.2), the net present benefit of prioritised investments is NOK -52.7 billion. The measured value to society is thus significantly *lower* than the cost.[6] In other words, the NTP includes many non-viable projects. In comparison, universal design measures often demonstrate excellent benefits to cost ratios. Shifting the focus away from large national infrastructure projects in the NTP towards smaller, local universal design measures would therefore likely result in a major socioeconomic gain.

6 The explanation given is as follows: 'This is because, when prioritising, the government has also attached importance to other considerations.' (Page 162).

Fearnley (2018) commented on this as follows:

'Measured in terms of net present benefit per krone spent on a measure (benefit-cost ratio), a shelter, a bench, or good lighting at a bus stop, for example, will easily outperform any NTP measure. By a good margin.'

It could be questioned whether it is right to rank universal design measures against completely different types of projects, such as NTP projects. In many ways, universal design is a basic requirement and a right. Unfortunately, the reality is somewhat different: in practice, there is not enough money to meet all important needs. Universal design is primarily a requirement for new-builds and major upgrades. In addition to universal design measures being funded from earmarked budgets, they can also be prioritised in competition with other worthwhile projects, based on estimated benefits and cost benefit analyses. As we have demonstrated, universal design measures are highly competitive in relation to projects covered by other budget items and can yield far greater benefits than most other investment projects in the transport sector. Measuring the overall value to society can therefore have a potentially significant impact on the work with universal design in the sector.

6. Concluding remarks

We can assume that between 10% and 20% of the population experience some kind of difficulty when travelling, whether it is situation-specific (like carrying luggage or pushing a pram) or in relation to something more permanent. This therefore affects a significant number of people.

'Between 10% and 20% of the population experience some kind of difficulty when travelling.'

Measures to make public transport, outdoor spaces and footways more universally designed and accessible have direct effects and benefits for users. The service becomes accessible, and people experience freedom of movement and the opportunity to participate in society. Universal design also has more indirect effects. For example, independence and mobility lead to better mental and physical health, reduced loneliness, improved quality of life and the possibility to serve as a resource for others.

Many measures to make transport systems more accessible for people who experience various difficulties are considered quality improvements by other passengers. Universal design measures can therefore also be viewed as general quality improvements. All passengers benefit from universal design measures because the services are regarded as more intuitive, safe, comfortable, flexible and easy to use. This benefit has been quantified in valuation surveys and is not insignificant. There are many examples where the passenger benefit of universal design measures far exceeds the cost of implementing them – they are therefore welfare improving. This is true even though it is challenging to quantify demand gains from such measures.

'There are many examples where the passenger benefit of universal design far exceeds the cost of implementing them – they are therefore welfare improving.'

There is still much research to be done on universal design. For example, there is a lack of knowledge about universal design and micromobility (such as electric bicycles and scooters) and cars. Additionally, the bulk of the existing literature on the needs of different groups primarily focuses on people with visual, hearing and mobility impairments. More knowledge is needed about other groups, such as those with allergies, cognitive challenges, gastrointestinal conditions and mental health problems.

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7

Transport solutions of the future: technology, design and innovation

JØRGEN AARHAUG

In the world of transport technology, most changes bring about better accessibility for more people. Yet technological advances tend to produce both winners and losers. Who wins and who loses will depend on how the new solution is designed and implemented.

This chapter describes transport solutions that are of particular relevance to the Norwegian context[1]. They will be discussed against the background of what we know about the needs of various user groups, as reported by earlier studies on universal design. The aim is to provide insight into the makeup of new transport solutions and how they will affect various user groups differently. The interaction that plays out between the technologies and the frameworks that impact on their adoption determines how the new transport solutions will influence society.

Jørgen Aarhaug

Jørgen studies the issues that affect adoption of new mobility technology. This includes topics like universal design and the regulation of passenger transport markets. Jørgen has a multidisciplinary educational background from the universities of Oslo, Helsinki and Cape Town.

1 This chapter draws on the same original work as Aarhaug (2023) Universal Design and Transport Innovations: A Discussion of New Mobility Solutions Through a Universal Design Lens, in Keseru and Randhahn (eds.) Towards User-Centric Transport in Europe 3. Springer, Cham. doi.org/10.1007/978-3-031-26155-8_10.

1. Introduction

Technological innovations are among the most important long-term drivers of increased affluence and good solutions. In this chapter, transport technology is not limited to accessibility technology, such as navigation aids for the blind. The objective is to highlight the fact that technology is not a neutral entity (Bozeman, 2020). It is a recurring challenge that new technologies, while making us more prosperous, also introduce new exclusions and may maintain extant exclusions. How new technology is adopted, is key. The text refers, in particular, to the needs of people with various disabilities, but the challenges are not restricted to these groups. Good design benefits all.

1.1 The car brought new solutions and challenges

Looking back, the fossil fuel powered private car was one of the most important technological advances of the 20th century, and the most important change within day-to-day mobility. It solved the problem of horse manure in city streets and the technology helped to significantly increase the mobility of individuals. Nevertheless, it also brought new challenges in relation to traffic safety, noise, urban sprawl and consumption of fossil fuels – as well as issues associated with inclusion. Large parts of the population have no access to a private car (Hjorthol, 2016) for reasons of age, health, disability, financial situation or ideology.

The population's relationship with the car changes with time, situation in life, and geography (Lunke, 2022). Bastian et al. (2016) claim that reduced prosperity is at the heart of a reduction in car ownership in parts of the Swedish population. Uteng et al. (2019) look to the importance of life events to explain a change in the take-up of car-sharing solutions. Attitudes also contribute (Nordbakke and Lunke, 2021).

However, a mobility system centred on car use is being challenged from multiple directions, including for its impact on the climate and environment. This has given rise to political targets like the ʻzero growth goal, the national strategy to reduce growth in road traffic (Tønnesen et al., 2019). But it also involves general ideas about which narrative tells the story of the good life and the involvement of less-resourceful groups (Nordbakke and Schwanen, 2014; Bjerkan and Øvstedal, 2020; Schwanen et al., 2015). In this context, universal design and mobility solutions for the general public can become increasingly important.

1.2 A window of opportunity for new technology

By challenging the narrative about the private car as being essential to our everyday mobility, we allow new technologies to gain access to the transport system, or existing solutions to be reconsidered and given a new role. This can be seen as a window of opportunity for new technology (Geels and Schot, 2007). Numerous reports have been produced about new transport technologies and their potential, in Norway and abroad, for instance as part of work on the Norwegian national transport plan, which previously assumed, implicitly, that our transport technologies would remain unchanged into the future.

I have based this chapter on work undertaken by the Norwegian Board of Technology to chart the technologies that are expected to influence urban mobility in Norway in the years ahead (Haarstad et al., 2020). A total of 16 technologies were selected for detailed description. These are grouped under the headings of *digital transport systems*, *micromobility, cars and taxis, and public transport*[2]. This list includes new physical transport technologies, such as electric scooters and autonomous cars, as well as new ways of offering transport services, like 'Mobility-as-a-Service' (MaaS)and co-operative intelligent transport services (C-ITS). This article describes a selection of these mobility solutions.

Universal design aims to achieve equality through good design rather than accessibility for specific groups of people. Universal design is not a set of special solutions for various user groups, but one overall solution for as many people as possible.

1.3 Universal design: one overall solution accessible to as many as possible

Universal design is about making the main solution accessible to as many people as possible. The concept of universal design is mainly used in the USA, Scandinavia and Japan, and there are clear parallels to other design philosophies such as 'design for all' (Audirac, 200) and 'inclusive design'. Universal design originated in the 1970s and stems from the architect Mace (1998), who coined the phrase to describe design of the built environment and services. The difference between universal design and accessibility is in the conceptual approach. Universal design aims to achieve equality through good design rather than accessibility for specific groups of people. Universal design is not a set of special solutions for various user groups, but **one overall solution for as many people as possible.** This impacts on the way that user adoption of new technology is perceived.

In addition to the design of the built environment and services, universal design has been used in education, ICT and transport. In the transport sector, it is particularly public transport that has been influenced(Audirac, 2008). Public transport and urban spaces receive considerably more attention in universal design literature that private arenas like cars and private homes. Technological changes in the public transport system are therefore key to the discussion of universal design in the transport sector. This represents a challenge, because many of the technological innovations are aimed at private rather than public transport.

2 Other options would include using one of the following reports, as they also list alternative transport technologies in a Norwegian context: (2018), Kristensen et al. (2018), Kristensen (2019); Bakken et al. (2017)

2. What is new technology?

In this context, new technology is closely akin to innovation and new 'gadgets', and new ways of doing things are indeed included in the concept. One of the important developments in transport-related innovation is the introduction of ICT, which is facilitating or 'general purpose' technology that works across sectors. In practice, this means that much of the innovation has not been about new ways of physically carrying people and goods, but about the way that physical transport is communicated.

'New technology generally increases the window of opportunity for action. Yet, this does not necessarily mean that everybody will be faring better.'

New technology generally increases the window of opportunity for action – making it possible to do more. However, this does not necessarily mean that everybody will be faring better. The technology and how it is adopted are not neutral entities. The fact that the pie is getting bigger, does not mean that everyone gets a larger slice. New technology normally produces both winners and losers, and the same person can be a winner as well as a loser measured against different parameters. It is not a foregone conclusion that those who benefit the most from the new technology will want to, or are in a position to, compensate those who fare worse for the losses they incur.

New technology is also not necessarily neutral in terms of distribution and inclusiveness. When a new technology enters the market, the way it is adopted is not a matter of chance, it is a result of decisions.

2.1 Who are the first to adopt new technology?

Innovation literature describes several models that demonstrate how new technology spreads and is adopted by the populations. Rogers' model (2010, 1962) is a classic example, which is also the most frequently used. In this model, new technology spreads like an S-curve. This makes the distribution of its adoption look like a normal distribution curve, where those who are first to adopt the new technology are typical 'trend setters', i.e. the 'urban elite' who can afford to invest in a flop. Thereafter, the technology is gradually adopted by the rest of the population.

In this model, the uptake of new technology spreads like an S-curve. This makes the distribution of its adoption look like a normal distribution curve, where those who are first to adopt the new technology are typical 'trend setters', i.e. members of the 'urban elite' who can afford to invest in a flop. Thereafter, the technology is gradually adopted by the rest of the population.

In the context of universal design, Rogers' model poses some challenges, one of which is the fact that new technology is often aimed at 'the elite'. The idea that a few people make use of the solution before it is adopted by the rest of the population, is not necessarily a problem. However, if the elite's consumption cannot be replicated, access to mobility will soon become worryingly unequal. For example, new transport solutions may require a certain type of smartphone (which is the case for some ride-sharing services), payment by credit card (which is the case with many international companies), a good financial position or a driving licence (car sharing). All these examples include components that large parts of the population cannot access3. Any new technology which is useful only to some, is not universal.

It may be difficult to avoid such bias. Many new mobility technologies on the market were aimed at typical 'early adopters', whose demographics tend to overlap with those of the originators. Also, many of the new technologies are being developed in and

3 As an example: Access to credit cards require a valid ID, the legal ability to give consent for transactions and credit rating, all of which excludes persons, who still may require access to mobility.

for a global market and any user involvement is limited to the question of how the technology should be adopted in Norway rather than what is included in the solution.

2.2 What is new technology? Examples

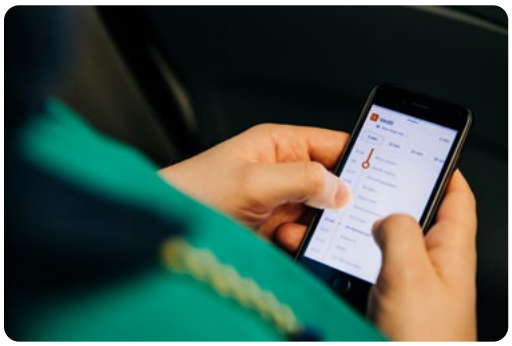

Photo: Ruter As. Nucleus AS, Magnus W. Sitter

The work undertaken by the Norwegian Board of Technology to chart technologies that are expected to influence urban mobility in Norway describes 16 new technologies. These are here grouped under the headings of *digital transport systems*, *micromobility, cars and taxis, and public transport.* All of these groups have been affected by the development of digital technology. These are technologies that tend to be categorised as being part of the fifth industrial revolution (Perez, 2003). Somewhat simplified, digitalisation can be described as the process of adopting digital technology. Digitisation is an important component in this process – i.e. that information is no longer handled as atoms but as bits (Negroponte et al., 1997). This means that the transmission of information is detached from the transfer of physical entities, which in turn opens the door to an array of new services and offers up existing services in new ways. Information that used to be difficult to access, like where the bus is, can be made available at a low cost and can provide more reliable information on board the bus, at bus stops and to passengers.

'Digitalisation is the process of adopting digital technology'

Therefore, digitalisation facilitates new commercial and non-commercial services based on available information. For instance, the information can be combined with promotions for the various transport services, or included on ticket-buying platforms. This allows people to make better informed choices about when, where, and how they wish to travel. At the same time, this can widen the divide between those who have access to this information, for example through their smartphone, and those who have not.

The fact that information can give more people access to better services if they can pay for them, raises a philosophical question:

2.3 Hva menes med «hovedløsningen»?

'Or is it enough that everyone has equal access to a minimum level of mobility?'

Does this mean that the overall transport system should provide mobility for all, or does it mean that each element of the transport system must be accessible to as many people as possible? Or is it sufficient that everyone has equal access to a minimum level of mobility?

The technologies that Haarstad et al. (2020) found to be most relevant, are listed in table 1.

Table 1. Relevant new mobility technologies, based on Haarstad et al. (2020).

TECHNOLOGY	STATUS	EXAMPLES	RELEVANCE TO UNIVERSAL DESIGN
Digital transport systems			
Mobility platforms/ MaaS	Pilot / scaleup	Whim, UbiGo, various apps / projects linked to major public transport operators	Considerable
Satellite-based road pricing	Ready, not implemented		Little
C-ITS (generic term for co-operative ITS)	Different stages	Geo-fencing, beacons	Considerable
Micro mobility			
E-bikes and small vehicles	Established	E-bikes, e-scooters, cargo bikes, unicycles, segways etc.	Noe
Shared micromobility	Established	VOI, TIER, BOLT, Ryde, oBike, ofo, Urban Sharing, etc.	Some, mainly due to misuse
Autonomous micromobility	Experiment		Potentially considerable
Cars and taxis			
E-cars	Established	BEVs from most manufacturers	Some
Car sharing	Established	Bilkollektivet, Hertz car pool, Hyre, hire companies	Some
Taxi-apps	Established	Taxifix, Uber, Bolt, Mivai, Yango, Grab, Didi	Some
Ride sharing	Established	GoMore, Samme vei	Little
Autonomous cars	Pilot	Waymo, Cruise	Considerable
Taxi drones	Pilot	EHang	Little
Public transport			
Demand-responsive buses	Established	Flex, pink buses, HentMeg etc.	Considerable
Autonomous minibuses	Established		Considerable
Autonomous bus fleets	Pilot		Little
Autonomous ferries	Pilot		Little

The technologies that are considered to have some or considerable relevance to universal design are discussed in detail below.

2.4 Digital transport technologies

Mobility platforms (MaaS / combined mobility) are digital platforms that combine the services of several different modes and operators in a single user interface, often made available through a mobile phone app. The main challenges for this technology have so far revolved around its implementation. The technical problems have proved simpler to solve than the organisational ones (Smith and Hensher, 2020). At the time of writing (2021), there is a multitude of experiments and services that can be characterised as MaaS but none of them play a key role in an established transport market. I am not familiar with any studies of MaaS from a universal design perspective. In principle, because MaaS reduces information barriers, the platforms should increase the public's opportunity to use a given transport service. MaaS makes it possible to receive better information about existing services and the extent to which they are available. The downside is that existing MaaS platforms require users to have a certain digital competence, the ability to pay online and access to a smartphone. If a public transport system is based on MaaS, fragmentation of responsibilities is a potential challenge in that it is unclear who is responsible for, say, wheelchair accessibility when the operator no longer has a direct relationship with the passenger.

'Mobility platforms (MaaS / combined mobility) are digital platforms that combine several different transport modes and operators in a single user interface, often made available through a mobile phone app'

Cooperative Intelligent Transport Systems (C-ITS) include technologies that enable vehicles to communicate with each other and with the infrastructure, and that are connected in a system. This is a set of technologies that over time may deliver more interconnected transport systems and more automation. This can make the transport systems more universally designed over time, through access to more and better information about what is happening in the system. One example is geofencing. This technology can create mobility zones, for example to regulate speed and parking restrictions for e-scooters, introduce zero emission zones, etc. 'Beacons' are another example that can make time and location-specific information about transport services accessible to the blind.

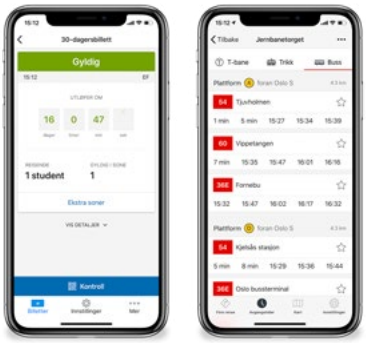

Photo: Ruter As. Ruter Designsystem

2.5 Micromobility

E-bikes and other small vehicles are referred to as 'micromobility'. This term covers a wide range of different initiatives, including cargo bikes, e-scooters and segways. Several of them can be used in mixed traffic lanes with pedestrians. To the extent that these modes replace cars, vans and lorries, they can make things easier for other road-users, but they will also increase the pressure on areas that are currently designated for walking and cycling.

E-bikes allow more people to cycle, and more people to cycle farther (Fyhri and Sundfør, 2020). This makes the bike a more universal mode of transport. E-scooters give access to motorised mobility for many who previously had no such access in real terms. From a universal design perspective, the parking of e-scooters when not in use has attracted significant attention. The fact that these small vehicles are abandoned on pavements and get in the way of wheelchair users can be hazardous for the blind and the partially sighted (Karlsen et al. 2023).

'Shared micromobility includes bicycles, e-bikes and e-scooters that are available for hire through a subscription or per trip.'

Shared micromobility includes bicycles, e-bikes and e-scooters that are available for hire through a subscription or per trip. Detaching ownership from use lowers the threshold for adopting the technology and is expected to improve access for more people. However, the majority of users are young, able-bodied people who travel within town centres (Fearnley et al., 2020). There are also vast regulatory challenges associated with free-floating systems, where bikes and e-scooters have no set endpoints(Fearnley, 2020; Sareen et al., 2021; Yin et al., 2019). Other challenges associated with space use and littering have caused the introduction of various local byelaws and nationwide regulations.

Autonomous micromobility involves small driverless vehicles. This technology is still at prototype stage but can potentially help to solve some of today's micromobility challenges by making motorised mobility accessible to more people. For example, people who cannot currently access services because they have no driving licence, will be able to make use of a driverless service. Potentially, this could also contribute to solving the problem of abandoned bikes in that the vehicles can park and reposition themselves. Yet this will not solve many of the other challenges posed by existing shared micromobility schemes, e.g. how people who are not young and able-bodied can make use of the service.

2.6 Car-based mobility

Electrification makes the car fleet more eco-friendly and makes the car more easily available for many4. In itself, this is of little consequence in relation to universal design and accessibility. However, EVs can serve to illustrate how new technology is introduced onto the market without universal design being taken into consideration. The first EVs were only able to meet the needs of a small proportion of the population because only a few models were available, all of which had a short range, and there were very few public EV charge points, etc. As the technology developed, more models were introduced to cover a wider range of needs (Figenbaum, 2020; Figenbaum et al., 2015).

Nevertheless, charging an electric car, and particularly fast charging, requires a relatively able-bodied person to handle the charger. Car sharing gives more people access to a car without having to personally own one. This may reduce car ownership, demand for parking facilities, and emissions to the urban environment (Chen and Kockelman, 2016). This can free up areas for other groups of road users and may have a positive impact on accessibility. However, it is not entirely clear what effect car sharing will have in the longer term because the patterns of use and participant motivation are still being moulded (Julsrud and Farstad, 2020). The impact of car sharing on universal design, is also uncertain. Car sharing is aimed at people who are able to drive standard-design cars and excludes those who cannot use this type of vehicle. Car sharing can therefore be said to widen the divide between the 'included' and the 'excluded'.

'Charging, and particularly fast charging, requires a relatively able-bodied person to handle the charger'

Taxi apps make a variety of transport services available via smartphones. How this may change accessibility to the transport system is up for discussion. Taxis are already the most accessible mode of transport. On the one hand, the apps provide easier access to taxis. For many users, their sense of safety is also boosted. On the other hand, the business models associated with the apps have many cases resulted in the de-professionalisation of taxi services and restricted the opportunity for local authorities to impose vehicle-specific requirements (Oppegaard, 2020). One outcome is that a lower number of cars are wheelchair accessible (Oppegaard et al., 2023).

4 This statement is not necessarily true in non-Norwegian contexts.

This raises the question: Is it enough that every operator has access to a number of vehicles adapted for people with various disabilities, or should every vehicle need to meet the requirements? The latter will involve considerably higher costs.

Autonomous or automated vehicles are a potential 'game changer' in the personal transport market. It is the Board of Technology's opinion that this technology will first affect the taxi market (Seehus et al., 2018). Autonomous vehicles are expected to make car-based mobility accessible to a larger section of the population and thus considerably boost the level of mobility, particularly for those who currently have no access to a car. The impact on other modes may also be dramatic, with significant increases in transport quantities and energy consumption as potential negative consequences. There are also important questions linked to how self-driving technology will be adopted, and the outcomes will largely depend on how these questions are answered (Nenseth et al., 2019; Kristensen, 2019).

'A car-sharing service is aimed at people who can drive a standard-design car and excludes people who cannot use this type of car'

2.7 Large vehicles

Demand-responsive buses (often bookable by smartphone) are closely related to MaaS and can help to make mobility accessible, thereby having a positive effect on universal design (Nordbakke et al., 2020). However, some studies, such as Skartland and Skollerud (2016), show that it is difficult to communicate flexibility, and that flexibility is perceived as an uncertainty, which has a negative effect on universal design. Like other services that are based, to a degree, on automated processing of bookings, various forms of demand-responsive

bus services may have the same weakness as taxi apps in that some potential user groups are excluded.

'Is it enough that each operator has access to a number of vehicles adapted for people with various disabilities, or should every vehicle need to meet the requirements?'

Autonomous minibuses can, once the technology has developed a little further, help to create a better integrated and wider reaching public transport system that provides a timetabled near door-to-door service. It is highly likely that autonomous minibuses can be designed in a way that satisfies normal requirements for universal design because they are generally expected to be used in the publicly funded public transport system. This will allow the public sector to specify the design of the vehicles in accordance with universal design requirements. The accessibility of autonomous buses is likely to be better than for existing buses, provided there is a service assistant aboard the vehicle. Autonomous buses should certainly be cheaper to operate than conventional ones, so that more vehicles can be made available to the public at the same cost while providing a better service.

It is the case for all the new technologies that innovations generally focus on putting features and services together in new ways. In the period 2010-2020, the opportunity to create better user interfaces through smartphones was particularly important. If we look ahead to the coming decade, it appears that driverless and emission-reducing technology will become more important. If driverless technology is adopted much more extensively than today, this will impact significantly on the way that many people think about transport and mobility for all. This is a popular field of research, but there is still considerable uncertainty. Like other scholars, Seehus et al. (2018) point out that the outcomes will depend on the frameworks that are put in place for driverless technology and its adoption.

'When the technology has developed a little further, autonomous minibuses will provide a better integrated and wider reaching public transport network and a timetabled door-to-door service'

2.8 What are the consequences of new technology?

Lenz (2020) points out that aside from the obvious benefits of better information flow and better access to information about transport services, many aspects associated with new transport technology and smart mobility remain unclear. For example, data flow across systems gives rise to new challenges with respect to risk, ownership and responsibility.

Photo: Ruter As. Nucleus AS, Daniel Jacobsen

Many aspects of new mobility technology affect people differently. In many ways, this new inequality is perceived as under-communicated. Typical users of new mobility services are described by Lenz (2020) as having many characteristics in common with the typical early adopters described by Rogers (2010, 1962): they are young, well-off, technology-minded and able-bodied.

'Typical users of new mobility services are young, well-off, technology-minded and able-bodied'

Depending on the up-take speed of in the rest of the population, the included population segments could either grow or diminish. Optimistic expectations suggest that greater mobility will be accessible to more people. Pessimistic expectations suggest growing differences between people, because some will win access to better mobility while others will retain their current mobility, or lose some of the mobility they currently have.

However, there are numerous examples of user involvement with the development and implementation of new technology in the transport sector, particularly in respect of public transport. Such user involvement is a statutory requirement and is often considered a positive initiative (Skartland and Skollerud, 2017). Examples include Ruter's work on journey planners and age-friendly transport. Navigation aids for the blind on smartphones, and contactless payment by mobile phone make it possible to avoid ticket machines and parking challenges.

It appears that the consequences of new technology largely depend on the way that the technology is adopted, i.e. what frameworks and regulations are introduced rather than simply the technology as such. The window of opportunity increases, but not necessarily for all.

Photo: Ruter As. Redink, Thomas Haugersveen

3. New possibilities – new challenges

3.1 What about the people who are excluded?

Studies of travel behaviours often find that people with disabilities travel less than the rest of the population (Nordbakke and Schwanen, 2015; Aarhaug and Gregersen, 2016; Gregersen and Flotve, 2021). People with disabilities experience a variety of barriers to transport (Bjerkan, 2009; Bjerkan et al., 2011) associated with long distances (Lodden, 2001; Nordbakke and Hansson, 2009), design (Aarhaug et al., 2011), maintenance (Aarhaug and Elvebakk, 2015), etc.

'People with disabilities travel less than the rest of the population'

A universally designed transport system is not a transport system that has been adapted to meet the special needs of a few. Some features that have been introduced to make the transport system more universally designed generally make all users rate the service higher, like step-free access to public transport vehicles, real-time information, automatic bus stop information and waiting shelters with seating (Veisten et al., 2020; Flügel et al., 2020; Nielsen et al., 2018). There is no contradiction between sensible socio-economic investment and universal design, rather to the contrary. To some extent, this is challenged by new technology.

Photo: Ruter As. Redink, Fartein Rudjord

The main trend is for people to opt for private transport the higher their income and affluence (Kristensen et al., 2018). This has no immediate bearing on universal design as new services are added to existing ones. But the indirect impact of this trend is potentially considerable, in that it may undermine the funding models for public

transport solutions which largely ensure that mobility is made available to as many people as possible. Aarhaug and Elvebakk (2015), Øksenholt and Aarhaug (2018) and others, studied the introduction of digital ticketing by way of an example.

Bus tickets were previously bought for cash from the driver who issued paper tickets with printed text and a stamp. This system ensured that passengers talked to the bus driver, who therefore knew where they were travelling to, and drivers could be made aware of any special needs that passengers might have, so that these could be accommodated.

This system was replaced by electronic tickets on proximity cards to be bought in advance of travel and validated on a pole aboard the bus. This created challenges for several user groups. The partially sighted (and people with other disabilities) found it very difficult to use the ticket validators. Points were also made about the uncertainty associated with recording of use and the validity of tickets. County and municipal authorities had chosen to grant free public transport to people with disabilities. One study shows that only very few of the people concerned had received this information and therefore were not aware of the offer. Consequently, the new ticketing system was perceived to be a barrier to use, although there was in fact no need for people with disabilities to relate to the ticketing system at all (Øksenholt and Aarhaug, 2018). It can also be questioned whether the decision to allow free travel for the partially sighted is good universal design rather than an exclusion mechanism. The proximity cards have later been supplemented with smartphones as ticket carriers, in most cases this does not influence the accessibility of the ticket.

Photo: Ruter As. Redink, Hampus Lundgren

3.2 Categories of challenges

The mobility impaired

For people with mobility impairments many transport-related innovations are good news. Better access to e-bikes can widen the radius of action for those who can use them. More demand-responsive public transport services facilitate door-to-door travel for more people, particularly where the feeder leg of the public transport journey used to represent a barrier to travel. Increased access to car-based services is also a positive in terms of participation – provided the people with impaired mobility have an opportunity to avail themselves of the offer.

A transition from bus-based services to car-based services can represent a challenge for wheelchair users, as this may reduce access to wheelchair-accessible vehicles. Another challenge is represented by the parking of shared-use e-scooters in public spaces in town centres, as this can constitute physical barriers.

The navigationally impaired

The digitalisation of information has generally helped to make travel much simpler for the navigationally impaired. Awareness about how information is communicated, and access to information on various platforms such as digital posts, automatic announcements, and on mobile phones, make the journey a better experience. The same goes for greater access to door-to-door transport services. Some studies have identified weaknesses with the implementation of the more sophisticated information systems. These are generally minor flaws in a development which is largely positive.

The visually impaired

For the visually impaired, many of the services offer increased access to door-to-door transport. This can be very useful. It is expected that this will improve even further when driverless transport is more widely introduced. This will see the removal of several (but not all) mobility barriers currently encountered by the visually impaired. The digitalisation of information about features on board public transport vehicles has already helped to reduce the barriers for the blind and partially sighted. It is a challenge for the partially sighted that new transport solutions, particularly micromobility, increases the speed of traffic in pedestrian areas and involves heavier vehicles (e-scooters are heavier than manual kick scooters, e-bikes are heavier than manual bikes, etc.) This increases the risk of accidents and the severity of such accidents. Moreover, several of the new transport services are only available through smartphones and apps, which can be challenging for the partially sighted.

Poverty

The fact that increased affluence generally leads to increased use of private transport solutions poses an inherent structural challenge from within the transport system. Several consequences of this fact impact on universal design. The revenue base for shared solutions is reduced when fewer people pay for tickets. In Norway, the severity of this impact is reduced by the use of toll fees and ordinary taxes to cover the cost of operating a public transport network. These monetary transfers from car users to public transport users disincentivise car travel and help to maintain a better public transport system than what user payments alone can pay for. However, as a redistribution policy instrument this system has only limited impact (Fearnley and Aarhaug, 2019).

It is a challenge that many new technologies involve considerable cost to the user. This can negatively influence the overall level of mobility in two ways: 1) Those who cannot afford the new technology will not have access to the increased mobility it brings. 2) When parts of the population transition to new mobility solutions, which are often private and user funded, this undermines the revenue stream that funds mobility solutions that others depend on.

3.3 How does new technology affect universal design?

More generally, there are several aspects of new technology that pose a problem when seen against the objective of a universally designed society. How new technology affects efforts to achieve universal design, will largely depend on the way that the new technology is adopted. This is a big and complex question. New technology clearly increases the window of opportunity. However, the capacity to adopt new technology is unevenly distributed. The introduction of new technology can therefore create new barriers, whether of a physical, technical, financial, or psychological kind. The practical implications stem not only from the qualities of the particular new technologies; they are also an outcome of how these technologies are adopted. Many of the innovations that have been introduced, particularly in the field of public transport, have made transport services considerably more accessible, e.g. real-time information systems, mobile ticketing and step-free access. Value estimation studies also show that these are interventions that most users benefit from, which aligns with the idea of universal design.

'The introduction of new technology can create new barriers, whether of a physical, technical, financial or psychological kind'

If we look back on the period 2010-2020, new technology has significantly improved the universal design of the transport system, particularly in the field of public transport. The digitalisation of information systems is an important contribution. We no longer need access to a physical timetable to check bus times; the information is available everywhere. And while it used to be impossible to know when the bus would actually arrive given the current traffic situation, as opposed to when it was scheduled to arrive, this is now possible thanks to real-time systems and the fitting of GPS on buses. This is a big advantage. The technology has also facilitated the display of far more reliable information for passengers aboard the bus, with automatic bus stop announcements and information screens. These interventions are highly appreciated by all passengers (Veisten et al., 2020).

Photo: Ruter As. Fotograf Birdy, Birgitte Heneide

4. Conclusion

New technology has helped to make transport, and particularly public transport, accessible to a larger proportion of the population. This means that society, at least with respect to the transport sector, is moving towards universal design. New technology helps to facilitate this development. As a consequence, there is an increased level of mobility, and more people have greater opportunities to contribute to society.

If we look to the future, several transport technologies that are currently niche, may potentially further strengthen developments towards increased mobility for more people. Autonomous motorised vehicles in a mixed transport system clearly have the greatest potential. This technology may be able to make mobility, at the level currently available to car users, accessible to more people. This will lead to enormously increased opportunities for people with disabilities. However, if we use different parameters there is also potential for disaster.

Model studies show that autonomous cars can help to reduce transport volumes. However, to achieve these results, the assumptions used in the models tend to be severe and unrealistic, like being able to force users away from private solutions and compel them to share, in a way which is currently unfeasible. When the same models are run with less rigorous assumptions, the scenarios become far less attractive from an environmental and social perspective (Nenseth et al., 2019; Kristensen, 2019). Yet again, the question is how the opportunities provided by the new technology are used.

If we look back on the latest decade, we have seen large-scale implementation of numerous new technologies that have sought to make public transport more user-friendly, e.g. real-time information systems, traffic information apps, step-free access, mobile phone tickets, automatic bus stop announcements. While many of these technologies were motivated by universal design, they have made the journey better for all.

If we look back on the 2010s, we have seen large-scale implementation of numerous new technologies that have sought to make public transport more user-friendly, e.g. real-time information systems, traffic information apps, barrier-free access, smartphone tickets, automatic bus announcements. Often, technologies that were motivated by universal design have helped to improve the journey for everyone.

While earlier research shows that universal design measures have provided significant socio-economic benefit, the same research shows that accessibility is not necessarily prioritised by commercial operators unless they are required to do so. This produces a set of political balancing acts. The legal framework, whether national or EU-wide, can serve as a tool to increase the benefit for all. Operators are forced to choose the solutions they ought to choose were their objective to maximise societal welfare.

'If new technologies like taxi apps, autonomous cars and e-scooters are to make the transport system more accessible to as many people as possible, in line with the idea of universal design, then regulations are needed.'

If new technologies like taxi apps, autonomous cars and e-scooters are to make the transport system more accessible to as many people as possible, in line with the idea of universal design, then regulations are needed. At the moment, it appears to be financially unviable for providers of new transport services to make these accessible in the way and at the level required to be compatible with the idea of universal design.

To reach the objectives of universal design, statutory regulations must seek to distribute the benefits of new technology in a way that enables people to take advantage of them even if they are not typical early adopters of new technology. This can be achieved by making stipulations for the design of new services, e.g. by linking the right to offer a commercial service to a duty to provide adequate accessibility, or by taxing services that inconvenience others and using the revenue to meet the mobility needs of those who cannot take advantage of the new technology.

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