Summary

Universal Design of Transport Systems in Norway

In this report we develop recommendations on how to progress the field of universal design in Norway. The recommendations relate to (1) Research (2) Legislation and (3) Practice. The report is based on a literature review, a study of documents relating to legislation and guidelines, interviews with national transport actors, and a case study in Trondheim.

There are several different definitions of universal design. In this report we use following the UN definition:

"Universal design means 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 specialized design. Universal design shall not exclude assistive devices for particular groups of persons with disabilities where this is needed."
(United Nations Convention).

Although universal design concerns everyone, we focus on children, elderly people and people with disabilities in both the literature review and the analyses of legislation and guidance. The reason being that

> 1) The literature on universal design, as well as BUDFIR itself, mostly follow this approach. Given that we seek to investigate imbalances between particular groups, it is natural to use the same grouping approach as the established research.
> 2) to map the needs of "everyone", we need to know the needs of people who have additional needs
> 3) assessing the needs of the people who have additional needs will automatically include the needs of everyone

There are many different definitions of disabilities and which groups are included in this term. We include the following groups:

	Disability	Descirpiton with examples
1	People with visual impairments	Various forms of visual impairment *Color blindness, blindness, tunnel vision, etc*
2	People with reduced mobility	Problems with moving all or parts of the body due to paralysis, pain, exhaustion or other physical/mechanical limitation. *Paralysis, musculoskeletal diseases, pain disorders, obesity etc*
3	People with hearing impairment	Different degrees of reduced hearing *Deafness, age-related hearing loss, tinnitus etc.*
4	People with developmental disabilities	Reduced intellectual, cognitive and social development. Sometimes referred to as intellectual disability. *Down syndrome, Fragile X syndrome and Rett syndrome, etc.*
5	People with psychosocial impairments	Mental disorders and behaviour-related disorders *Anxiety, depression, personality disorders, bipolar disorder, PTSD, ADHD, Asperger's, etc.*
6	People with cognitive impairments	Learning difficulties and memory problems. *Afasi/dysartri (talevansker), dysleksi, demens, Alzheimers m.m.*
7	People with respiratory problems and other environment-related barriers	Reactions in the respiratory tract (m.m.) due to lung damage, pollution or other environmental stresses *Asthma, allergy, COPD etc.*
8	People with seizure-related illness	Seizure illness, but also illnesses that can cause seizures of various kinds *Epilepsy, migraine, diabetes, heart disease*
9	People with digestive and urinary tract diseases	Diseases that affect bowel/bladder function *IBS, overactive bladder, Crohn's, Ulcerative Colitis, various forms of cancer, food allergies*

People with certain conditions could be placed in several groups. For example, allergies could lead to digestive issues but also respiratory problems. Severe food allergies causing anaphylactic shock could also be placed under the group with seizure-related illness. People with different types of cancers could also fit into different groups. Also, there might be people illnesses that do not fit naturally into any of the groups - for example insomnia, alopecia – but because they have conditions not directly affecting travel or affected by the design of the environment, services and programs, they are not included.

Literature study

We conducted a literature review of approx. 40 studies where we looked at the type of study, which groups and means of travel are included, as well as which methods were used. We also summarized the main findings in these studies.

Knowledge summary

Problems and barriers different groups encounter in the transport system are summarised in Table 2. There may also be more measures than those listed here and several of the measures listed will help several groups. As we can see many of the measures are useful across groups, and most of the measures also generally help to improve the everyday travel life of most of us. Good information, seating, access to toilets, barrier-free access and available personnel are factors everyone benefits from. Many of the measures are also something most people are willing to pay extra for (Veistein et al. 2020).
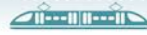
| Area	Solution	Mobility	Visual	Hearing	Respiratory	Cognitive	Psycosocial	Developmental	Seizure	Digestion and urinary tract	Other (gender, age etc.)
Toilets	Existing	x	x				x			x	x
	No self-service		x								
	Open	x	x				x			x	x
	Discrete									x	
	Sound proof									x	
	HC toilet	x									
	Enough space on both sides (HC)	x									
	Not wall hung (HC)	x									
	Location of flush button/paper adapted to wheelchair (HC)	x									
	Fragrance free handsoap				x						
Information	Real time system available		x	x			x				x
	Screens adapted to different heights	x									x
	Auditiv information	x	x			x					
	Large text		x					x			
	Tactile dashboards		x								
	Teleloop			x							
	Low noise level			x							
	Avoid scrolling text					x					
	Symbols		x			x					x
	Limit information noise		x			x			x		
	Good lighting conditions (problem: backlit window surfaces, contrasts)		x	x		x					x
	Visual information (light alarm in case of fire)			x							
	Available personnel	x	x			x	x	x			x
	Consistent use of warning and danger fields (for blind)		x								
	Standardised systems		x			x	x				
	Automatic call for bus		x								
	Readable timetable (not PDF)		x								
Seating area	Seats available station/on board/to-from	x				x	x				x
	Screened seating						x				
	HC seats - number and location	x					x				x
	Pet-free seating				x						
	Safety chain for wheelchairs (bus)	x									
	Plenty of space (no crowding)	x					x				
	Maneuvering space for a wheelchair	x									
Walking area	Free from ice/snow	x	x								x
	Leadlines without obstacles		x								
	Obstacle-free walkway (signs, scooters)	x	x								
Orientation	Logical numbering of platforms		x			x					
	Lead lines without abruptions		x			x					
	Contrasts on doors		x								
	Handrails on stairs		x								
	Automatic doors that do not open too quickly		x								
	Standardized design		x			x					
	Marking of glass surfaces		x								
	Prioritize natural lead lines in the design. Tactile pavement where there are no natural lead lines, or when warning of danger		x								
	Marking of alternative route	x									
Personnel, assistance	Information when unforeseen events		x				x				
	Available personnel with ticket purchase							x			x
	Expertise on different needs						x				
	Driver stops at marked boarding points	x	x								
	Assistance button in vehicle	x	x				x				
Organizational	Waitingtime between modes of transport						x				
Physical environment	Low-enterence	x									
	Gap free acceess between platform and mode of transport	x	x								x
	Elevator	x									x
	Ramps	x									x
	Allergy friendly plants				x						
	Plants to reduce airborne pollution				x						
Other	Information about hidden disabilities				x		x				x

Knowledge gaps

The studies we have examined have been divided into 4 different types:

1. Knowledge summaries containing both literature studies and textbook chapters

2. User studies that look at what type of barriers users encounter in the system and potential measures to address them – includes both interview studies with individuals, follow-up studies and focus group interviews.

3. Valuation studies that evaluate the costs-benefit or effects of various measures

4. Organizational studies that look at the transport system itself and how organization, planning, regulations/laws etc. affect universal design

The table below shows how the studies are divided into these categories.
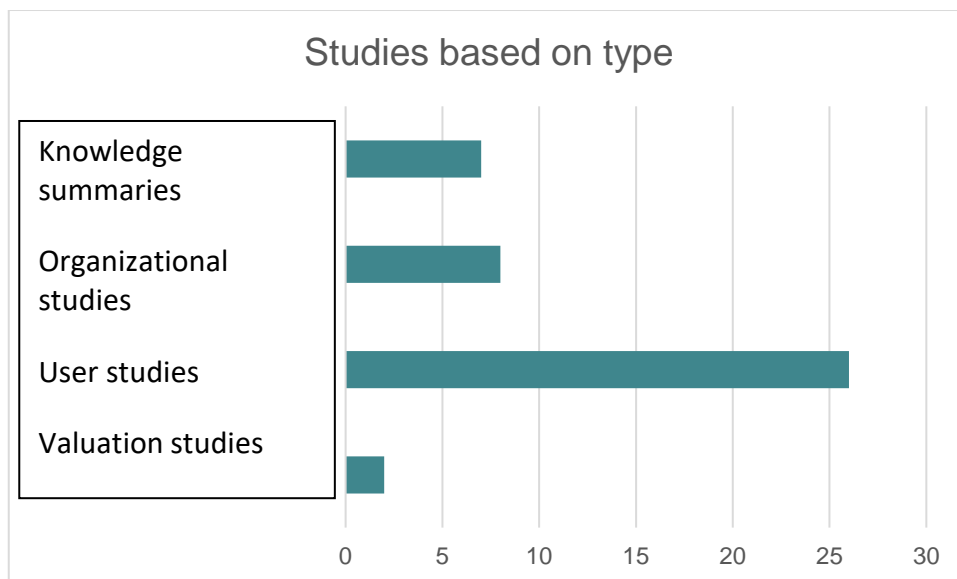
As we can see, there is a lack of both valuation studies and organizational studies, compared to user studies. As expected, there are relatively fewer knowledge studies, as they are based on a number of studies. More valuation studies are needed to assess measures for maritime and air transport, as other forms of transport were well covered in a large study recently carried out by Veistein et al. (2020). In addition, there are certain barriers that have appeared in the literature study that should also be included in future valuation studies – for example, availability of toilets. When it comes to organizational studies, this is a very broad field, which also makes it more difficult to summarize knowledge gaps. Based on the studies done to date, there are few studies looking at i) how universal design is addressed in regional and municipal plans, ii) review standards for groups other than the blind, and iii) case studies looking at collaboration and user participation. Since organization is context-specific, there is a general need for more case studies in this area. Although there are relatively many user studies, they have shortcomings including a lack of accounting for people with conditions other than reduced mobility, sight and hearing – as shown in table below.

Study by group of disability (n=27)
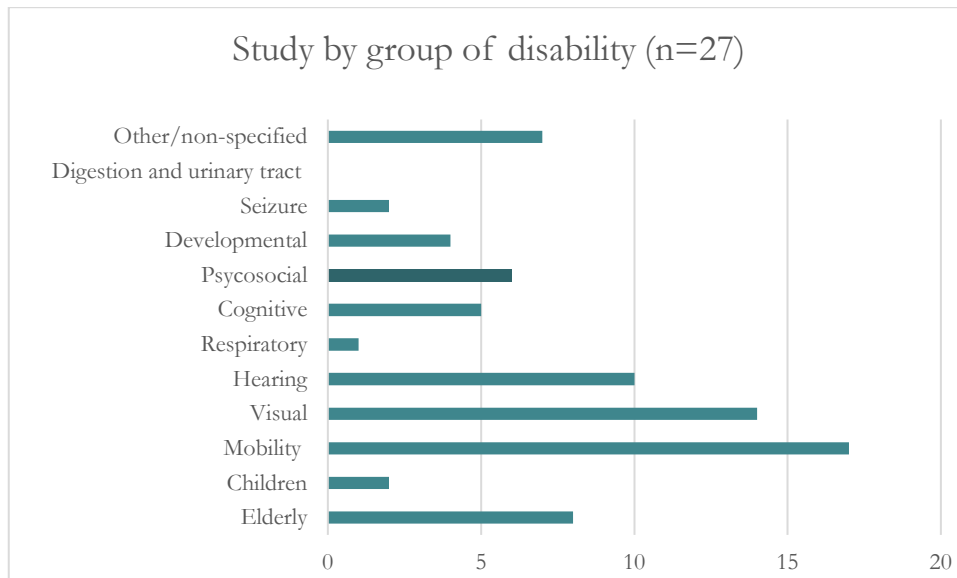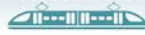
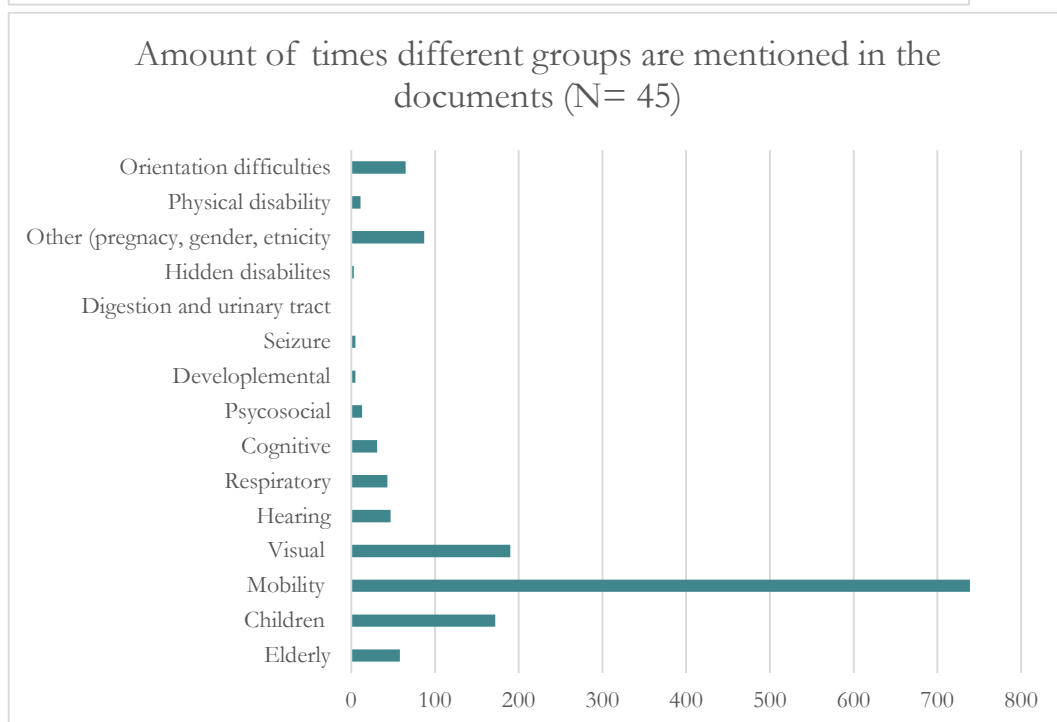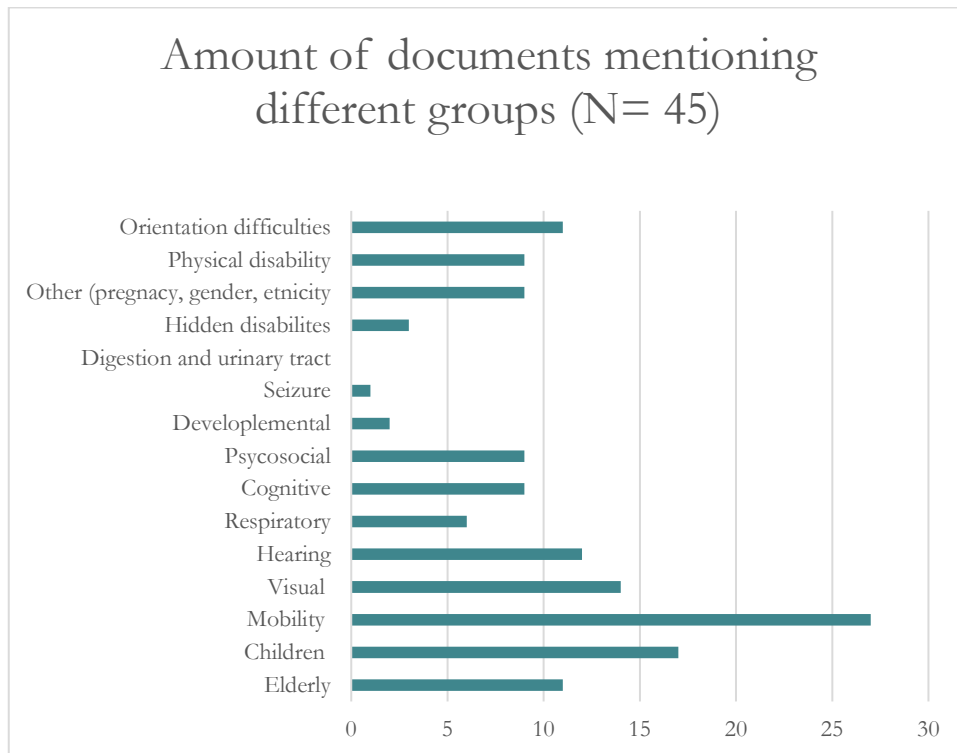**Document study of legislation and supervisors**

We have gone through 45 legislative and guidance documents that deal with universal design. We have carried out both a qualitative review to consider use of terms, content and definitions, and a quantitative analysis of word usage to map which groups of disabilities are in focus.
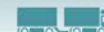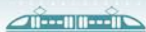
In the qualitative review, the main findings were:

• The definitions of disabled are very different between research documents and legislation, where research speaks of mobility impairment as a subgroup of disability, while in legislation it is used as a synonym for all types of disability. The reason can be linked to the two conflicting definitions used in the Great Norwegian Encyclopedia (SNL). This is problematic because it can influence which groups are in focus and which are not, and it can easily lead to misunderstandings between different professional groups.

• The definitions of universal design are also different between different documents. The Norwegian Act relating to equality and a prohibition against discrimination (Equality and Anti-Discrimination Act) emphasizes physical environment, although the UN's definition is much broader. This could possibly explain the biased focus on technical solutions in the physical space compared to solutions addressing needs and barriers.

• Technical specifications differ between different forms of transport, which prevents a uniform standard across the entire system. The design of toilets for disabled people and the use of pictograms are two examples of this.

• There is a lack of pictograms for people with disabilities that are not visible.

In the quantitative analysis, we find that there are large differences between which groups are in focus - people with reduced mobility, and especially wheelchair users, as well as people with visual impairments and children/people with prams are mentioned the most number of times. They are also mentioned in the largest number of

documents - although here there is a less marked difference compared to other groups. Except for the focus on children, this focus corresponds to the focus in the research literature.

Amount of documents mentioning different groups (N= 45)

Group	
Orientation difficulties	
Physical disability	
Other (pregnacy, gender, etnicity	
Hidden disabilites	
Digestion and urinary tract	
Seizure	
Developlemental	
Psycosocial	
Cognitive	
Respiratory	
Hearing	
Visual	
Mobility	
Children	
Elderly	

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Interview study among transport operators

Interviews were conducted with nine different actors from the transport sector: Ruter, BaneNor, NorskeTog, Vy, Avinor, Statens Vegvesen, Bodø Municipality, Vestland County Municipality, Skyss and Entur. Interviews included questions on resources, cooperation, reorganization, technology and legislation.

When it comes to resources, most of the informants have their own dedicated human resources who work with universal design, often a person where universal design makes up 30-100% of the position. Just over half mentioned that there were too few resources for universal design, and that this can often be a factor that makes it more difficult to prioritize collaboration beyond one's own organization. When it comes to competence, it varies between the various actors whether they use internal or external competence in their work - but several informants point out that it can be difficult to obtain competence, and that there is a lack of focus on universal design in the Norwegian education system. Although there are still challenges related to competence (often relating to the need for competence in all parts of the organization), the main picture is that today it is much better than in the past when universal design was an unfamiliar concept to many. In relation to financial resources, the biggest problem is that there is a lot of older infrastructure that is expensive to upgrade. It may also be more difficult to upgrade older infrastructure rather than build new.

Collaboration is felt to be very important, and especially in interface and hub design. Although e.g. the station handbook specifies the regulations, there may nevertheless be ad hoc solutions developed without full cooperation between the various actors. Collaboration today appears to evolve somewhat haphazardly, and there is a lack of systematic process for collaboration, which is often project-based. Collaboration by engaged actors often results in good solutions for all parties. Collaborative forums such as 'Toggruppa' and Bufdir's UU network are of great value, and contribute to common solutions, professional exchange and transfer of expertise. However, it is important that the mandate for cooperation is clearly formulated and has a clear direction. As mentioned, a lack of internal resources means that there is often little time for the exchange of experience and network collaboration - it is more about resources than will when it comes to collaboration. In relation to collaboration with user groups, the actors express great benefit from this, but we also see here a focus on people with barriers related to movement, sight and hearing. This is probably both linked to the fact that the knowledge of those who work in the industry is largely linked to the knowledge that exists in the research literature and how the focus is in the legislation, but also to the fact that the interest organizations get involved to varying degrees on behalf of their own users.

When it comes to **reorganization**, the railway reform, the regional reform and the road reform have helped to influence the prerequisites for work with universal design. Although some actors have not noticed major differences before and after, there are certain other actors who have had completely new tasks or new actors to deal with. On the railway side, the division of roles has become clearer, but at the same time there has been a longer distance between those who work with the customer and those who order train material - which in the long term could potentially affect the end customer if the cross-functional cooperation between the new organizations does not
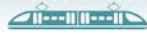
work well. But it is still uncertain how much this will mean in practice. The road reform and the regional reform have generally led to a strengthening of universal design competence in the county council, while National Public Road Administration is still in the process of finding solutions for how the universal design work should be organized further. County and municipal reorganizations have contributed to the fact that transport planning and other municipal (area) planning are now better seen in context. Furthermore, it seems that centralized management e.g. at Avinor can give greater emphasis to standardization and good joint solutions for all the terminals, as is also sought to be achieved within the network in the 'Toggruppa'. Improved international standards are also expected to have a positive effect on the train side both in terms of universal design of trains, stations and the interface between these.

Many of the players are working on projects where **new technology** can potentially solve problems for certain user groups. Automation, digitalization and electrification provide new ways to help people. But even if technology can potentially address the problems of different user groups, there are also potential negative effects. One representative explained that there is a naïve belief that technology will solve everything. She points out that even if you have a self-driving car, you still haven't solved problems such as how, for example, a blind person is supposed to find out which self-driving car to get in or what to do if something unexpected happens. Another actor believes that the technology can exclude certain groups - especially people over 80 years old who tend less to have or use a smartphone. This is supported by the literature.

With regard to **legislation and guiding documents**, several of the actors find it difficult to be up-to-date on the latest available versions and what exists. It is a comprehensive system of legislation and guidance documents. The actors point out that the guides (which are often drawn up by the interest organizations) can provide good practical solutions to various problems, but that disagreements can also arise between the actor and the interest organization about what can be implemented in practice. What is in the guides is also not required by law. Several players miss the fact that the legislation is stricter as it is easier to set requirements if you have authority in the law. In addition to legislation and guides, there are also several players who create their own guides and standards. This is problematic in relation to achieving standardized solutions across the board. Ideally, legislation and guiding documents should be raised at international level in order to achieve the most comprehensive travel chains possible.

Case study Trondheim

Representatives of actors who influence a particular travel chain in Trondheim participated in (i) an inspection of the travel chain; and (ii) a workshop to analyze the social and structural components that enable the travel chain to be designed universally (systems analysis).

At the workshop, the participants identified 16 system limitations that the various actors must control together for all customers to experience the travel chain as accessible. The participants found that it is important to control both the design of various parts of the travel chain, as well as the operation and maintenance of measures that contribute to universal design after they have been implemented. Parts of travel chains that must be designed, operated and maintained universally include
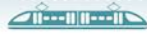
ticket booking, routes to/from/between stops, stops / stations / terminals, boarding and alighting, means of transport, and information before/after and during the journey.

At the workshop, it was concluded that good design is essential for universal design and a system must be simple and intuitive for everyone to use, regardless of ability. The overall design of a travel chain, which includes orientability and accessibility for all customers along the entire travel route, are very important aspects. In addition to overall design, the participants indicated that actors who influence the travel chain find that universal design of (i) routes to/from and between stops; and (ii) boarding and alighting, are most challenging to achieve. The need for collaboration to solve these challenges is highlighted by an analysis of the system's control structure, which shows that 47 "control loops" between the various actors and processes affected the universal design of the travel chain in Trondheim.

From an analysis of collaboration on the universal design of boarding and alighting and links between stops or hubs, we identified the following needs:

1. More systematic and regular feedback "from the bottom up" about challenges experienced by customers and employees
2. Shared understanding across administrators, operators and infrastructure owners of how universal design can be implemented in planning phases and in improvement work.
3. Cooperation on transitions along the entire travel chain, especially related to maintenance and system challenges.
4. Collaborate on processes for handling deviation situations so that they are manageable for all passengers.
5. Systematic cooperation on
   a. recognizable components along entire travel chains
   b. orientability and accessibility for all customers who travel along various travel chains.

The case study also resulted in proposals for solutions for systematic collaboration on the overall design of entire travel chains. Extending existing collaboration (e.g. annual inspection of selected itineraries) to include universal design can be an effective way to improve overall design for all customers across different elements of a travel chain.

Several collaborative initiatives have been started to achieve consistent use of symbols and pictograms across travel chains locally and regionally, but these do not look at how signs, symbols and other tools work when they are put in context. There is a need for a process which ensures that measures implemented in one part of the travel chain also match those used in another part.

In order to obtain sufficient expertise to meet the challenges, it may be necessary to bring in new collaboration partners from other sectors who understand the challenges that different users face in practice (e.g. health and welfare).

Recommendations

Based on the previous studies, we make the following recommendations relating to research, legislation and supervisors, as well as practice.
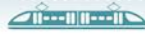
Recommendations related to further research

1. Need for studies that look at a wide range of user groups and needs
2. Improvement of quantitative studies on disabilities (RVU)
3. Need for a universal design perspective for car and bicycle transport
4. Need for studies that look at maritime and aviation transport
5. Need for studies that look at the impact of newer technology on universal design
6. Need for organizational studies

Recommendations related to legislation and supervisors

1. Need for unified definitions of universal design that cover more than just physical conditions
2. Need for a uniform definition of mobility impairment
3. Need for pictograms/signs for hidden disabilities
4. Need for standard guidelines
5. Need for increased focus on groups other than visible physical impairments
6. Need for stricter legislation
7. Need for legislation that keeps pace with technological development

Recommendations related to practice

1. Management engagement in universal design
2. Need for collaboration across the sector/industry
3. Need for more collaboration in the interface transitions to create holistic systems
4. Building on existing collaborations and forums
5. Need for wider inclusion of user groups
6. Need for competence and educational provision
7. Need for resources to upgrade older infrastructure
8. Maintenance and operation must be prioritized on the same level as new development
9. There should be separate formalized human resources that work with universal design in all organisations
10. Need for a good feedback system about deviations (checklists, user surveys, external checks)
11. The UU requirements must be made explicit in the tender notices
12. Data sharing must be higher on the agenda
13. Need for increased focus on non-conforming situations