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A cost effeciency approach to universal access for public transport for disabled people

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1.1 The cost-benefit approach to universal access to public transport.

The theoretical basis for cost-benefit analysis is the welfare economics. One main assumption to develop the theoretical platform, is to transform the individual utility to willingness to pay in the market and then add the different individuals willingness to pay implicit accepting the income distribution in society. This is acceptable if we have a well developed system of measures to achieve the income distribution that is political wanted. You can then separate the efficiency issue from the income distribution issue. The ethical justification for adopting this approach has been the subject of a long literature. That most fully articulated in recent years is the social contract theory of Rawls (Rawls, 1971). This again considers the choices made in an initial position, but this is now defined to be a state such that people have no knowledge of their social position or preferences. This "veil of ignorance" is assumed to ensure that the choices of moral principles is impartial or just; it is asserted that the decisions made by people in that hypothetical position behind the veil of ignorance are an acceptable basis for a theory of justice.

This Rawlsian perspective is in particular important when dealing with disabled people and a cost – benefit approach to universal access to public transport. It seems like the society has a moral collective willingness to pay for accessibility to public transport and therefore the total benefit can be higher than the aggregated benefit from each individual. Everybody have a risk to be functionally disabled and the value of avoiding this can be calculated ex post, but is difficult to forecast ex ante.

Universal access to public transport for people with a disability will help to greater participation in community life generally and are likely to have major social benefits for this group. The group is quite small and total willingness to pay in most cases too small to come up with benefits higher than costs. But in a Rawlsian perspective it can seem just to make public transport universal accessible to this group. One case that we have looked into, is ramp equipped low floor buses with adopted infrastructure. Because this will give benefits to a variety of groups like parents with small children, aged people and people with heavy shopping or luggage and those with temporary disabilities, total benefits will be high. We may also have some cross-sector benefits that can save public spending on disabled people. In this case total benefits might be close to cover total costs. But for the minority group of disabled, for whom this changes are most important, the benefits is far below to cover total costs.

Our theoretical discussion show some of the difficulties by traditional CBA-analysis in measuring consequences for people with disabilities:

- We have problems to get a clear measure on the objective of the project. Accordingly we have difficulties to compare measures from cost-efficiency
- Further we have problems by measuring the benefit from the efforts. And therefore it's difficult to determine if we have a profitable effort.
- We also have problems with the distribution issues from the measures and we can not add individuals utility without assuming something about distribution. For people with disabilities we have to attach much weight to distribution effects.
- The target group is relatively small and the aggregated benefit from the group therefore often are too small to cover the costs by the measures.
- It is not always correct calculating benefit with quantitative measures. Besides the target group's willingness to pay, it can be correct also to take into account the collective willingness to pay to secure the target group a minimum standard of public transport.

With all these difficulties connected to CBA-analysis related to disabled, maybe economical analysis of these measures should rather have focus on standard claims, that we try to cover in the most cost-effective way. Therefore we have not tried to calculate the social benefit from accessibility efforts (besides some simple calculations on local route buses), but concentrated the economical analysis on the costs.

The costs of implementing the measures on the ordinary public transport supply seem to be very high. Especially if the goal of full accessibility should be satisfied. In the transport sector this means replacing most of the old equipment.

1.2 CBA-analysis related to make local route buses more accesible

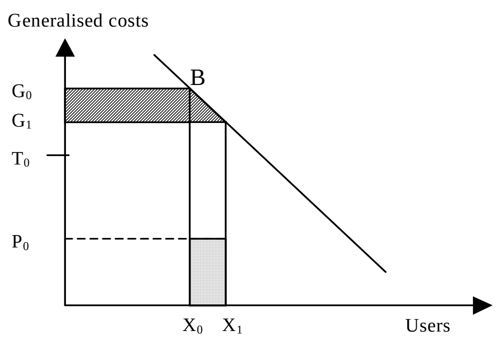

Figure 1: Benefit from an increase in accessibility on local route buses

In figure 1 initially X_0 people are travelling with the bus. The fare is P_0 and the value of time is illustrated with T_0. In addition we have some inconvenience costs by difficult accessibility to the bus. The total generalised costs are illustrated by G_0 in figure 1.

Then the bus company is replacing their old high floor buses with low floor buses equipped with ramps, and the public is rebuilding the bus stops. This will give the passengers less travel resistance and the generalised costs decreasing from G_0 to G_1. With a price elasticity that gives the slope on the demand curve illustrated in figure 1, the consumers' surplus from the decrease in inconvenience costs is like the hatched area in figure 1. The hatched rectangle illustrates the consumer surplus from the already existing travellers. This is a relative big group which for instance are containing elderly people with some kind of immobility, parents with small children and people travelling with heavy luggage. The hatched triangle illustrates the benefit from the new generated traffic. Here we sure can find a number of disabled people, but as we can see it is a small group.

If the total hatched area in figure 1 are higher than the costs per year by new vehicles and infrastructure, then the project gives us social-economic surplus. The benefits from the effort can exist of many conditions. If 20% of the existing users have utility from the measure and if everyone are willing to pay 5 NOK for the increased accessibility, then it will have given a gain per year on 200 mill NOK. With a 5% increase in traffic, the triangle illustrated in figure 1 will constitute 25 mill NOK. The costs by replacing all old high floor local route buses in Norway with low floor buses equipped with ramps or lifts and to modify the infrastructure,

will constitute 300 mill NOK per year. So the benefit from our calculations so far can not cover the costs. But there is some side effects that we have not take into account.
For instance we have not included the option value that some users have from the increased accessibility. With these group constituting about 20.000 people and their willingness to pay are on 500 NOK per year, this will give 10 mill NOK per year.

We also have forgot to take into account the benefit from that better accessibility can relieve families and friends with less driving. If we assume a decrease in such travels with 200.000 per year and that the earning to avoid such a travel is 50 NOK, the saving can be 10 mill NOK.

A better working public transport may also get people switching over from using adapted transport for people with mobility problems, the so-called AT-transport. In Norway the public funding of AT-transport constitute 540 mill NOK per year. A saving of 10% here will constitute 50 mill NOK.

Another moment to put into the calculation is that the better accessibility can make it easier for more people to take part in labour. If the better accessibility to public transport would have given 1% of functionally disabled in Norway a job, it would bring a gain of 350 mill per year. Then the measure are profitable.

The goodness of the project, also depends on the increase in public funding. In figure 1 the dotted area illustrates the increased income in the bus companies. Experiences from other countries are telling us that the increase in income hardly not are over 20% of the increase in the costs. Therefore with a cost of 300 mill per year, the public subsidies to the companies are going to increase with 250 mill NOK per year.

Our calculations are showing benefit values that significantly can cover the costs. However it is difficult concluding that it gives a social economic surplus, because of the uncertainty in the calculations.

1.3 Universal arrangements versus selective

Public transport for the disabled can be arranged in many ways. We usually distinguish between universal and selective arrangements. Generally the problem with universal systems is often that they are expensive and little accurate in relation to the target group. In contrast the selective arrangements are more accurate in relation to the target group and cheaper, but they have other drawbacks, like increased administration costs by finding people who have rights to the arrangements (with opportunity to misuse), together with the disabled's feelings of not being included with equal rights in society.

When discussing accuracy from a measure, we have to go trough the following points:

- To define and describe precisely the source of the problem
- To evaluate the measures accuracy in relation to the source of the problem
- To calculate cost-effectiveness, i.e. costs per unit influencing the source of the problem
- To choose the most cost-effective measure.

Transport efforts in the local traffic towards disabled, for instance can be to make the ordinary bus supply more accessible. This is mentioned as a universally effort, and can for instance be replacing high floor buses with low floor buses and preparing the buses for lifts and ramps to accommodate wheelchairs. Table 1 shows the status of some accessibility efforts on local route buses in some countries.

Country	**Share of low floor buses**	**Ramps/lifts**
Norway	20%	1% have ramps
Sweden	50%	Unknown
Finland	Large share	100% have ramps
Danmark	Large share	Unknown
Germany	90%	Ramps/lifts are in use
Great Britain	Unknown, but increasing, e.g. in London	Only ramps on buses in London
France	Little widespread	Little widespread
Spain	Ca 50%	Ramps are usual on new buses

Table 1: Status of accessibility efforts on local route buses in some countries (Aslaksen, 2000).

It is a sliding change-over to selective measures. The service bus is a route bus that often is organised for booking in that way that you can get the transport to your door. It is often a flexible minibus with low floor and with space for wheelchairs. Therefore the service bus in many cases will be a good solution for people with disabilities. We have done some investigations in Ålesund that show that service and booking routes specially are used by elderly people suffering from some form of aged-related immobility. Mainly the trips with these buses are related to leisure time, shopping and medical treatment. Therefore the travelling often take place outside the rush periods (Lyche & Hervik, 2001), (Kolstad, Solvoll, & Brastad, 2000). Meeting the demand from this group with small flexible buses, will be a relatively cost-effective solution because of unoccupied capacity in the transport company. In that way the companies can make the most of the equipment and drivers. The shadow prices in these periods are comparatively low. It is not correct to use the average costs calculating the total costs by using this kind of transportation. It is only the marginal costs and the operating costs that should be taken into account, while the overhead costs and the drivers' wages should be held outside. In Sweden (Göteborg) and Norway (Lillehammer, Trondheim and Ålesund) such transportation supply have been successful (Lyche & Hervik, 2001), (Aslaksen, 2000), (Oppland Fylkeskommune, 1996).

The next step on the measure menu, is to supply ordinary taxis, where people with disabilities have access to some social support through the national insurance. Further we have specially adapted transport for functionally disabled people, the so-called AT-service. It is organised as a taxi-based door-to-door service. If you can prove that you have special needs, you can get free taxi-tickets. Both ordinary taxis and special mini buses are used in the arrangement.

At last the disabled also can use their own car and many also have the rights to receive national insurance to implement special equipment in their car. In many cities there also are special parking places for disabled that are making it easier to use car.

It is not obvious what kind of transportation which is most cost-effective. It will for instance depend on population density. Our investigation in Ålesund and other investigations in Norway shows that for people with disabilities, the distance to the bus stop represents a great deal for choosing means of transport (Lyche & Hervik., 2001), (Kolstad et al., 2000), (Oppland Fylkeskommune, 1996). Especially in Norway this element is important, because of the climate with long snowy winters. For wheelchair users, who are taking part in work, often taxi beside own car will be the only useable means of transport. Therefore in Norway going for increased supply of taxis, often can be most cost-effective and at the same time give disabled less generalised travel costs. In this connection the taxi bill and the supply of specialised taxis, that can take wheelchairs, are important. Even if every travel with taxi will be more expensive than an ordinary route bus trip, the comfort, specially in the winter for disabled people travelling with taxi, will give generalised costs that are much lower than travelling with bus. Especially if the target is to get more people with disabilities in to work, lower generalised costs by travelling with taxi, will be a more accurate effort than a universally accessible bus supply. With a public funding of 250 mill NOK (the costing of an universal bus supply), a free daily trip with taxi could have been given to 10.000 disabled. If all these people, with this initiative, would have entered a labour market with shortage in working power, the gains would have been about 3,5 billion NOK.

The service and booking routes also can have high accuracy. Especially for people travelling outside the rush periods. As mentioned above, it is, because of free capacity in these periods, cheaper for the bus companies supplying such buses instead of ordinary buses. Our investigation in Ålesund indicates that service routes can take over many AT-users. 30% of this travellers stated that they are able to alternatively use the service route or other public transport. In an investigation done in the county of Nordland over 40% of the AT-users stated that they could consider increasing their use of public bus service if this was better adjusted for functionally disabled people (Kolstad et al., 2000). Experiments in Lillehammer indicate the possibility of a differentiated public transport system. Looking at ordinary buss supply, booking routes, service routes and the AT-system as complement goods in an aggregated public transport market, disabled people can be given a better transport standard for lower costs. One of the consequences of the experiments is that for people living along the service- and booking routes are not possible to get approval as AT-users (Oppland Fylkeskommune, 1996). With a 40% reduction in the number of AT-users, the public saving in Norway will be about 220 mill NOK per year, ignoring the extra subsidies that will be needed for the public transport. Table 2 shows the public subsidy per passenger on different organised transports in Lillehammer in 1994 and 1995. With this representative volume of subsidy, the public saving may be about 110 mill NOK per year for the whole country.

Kind of transport	**1994**	**1995**
AT-transport	55 NOK	54 NOK
Service buses	29 NOK	39 NOK
Booking routes	23 NOK	24 NOK

Table 2 Public subsidy per passenger on different organised transports (Oppland Fylkeskommune, 1996).

In Ålesund the objects of the interview stated that the frequency means a lot for increasing use of the service route. Specially it was a wish that the bus should carry on later in the evenings. Many users could also have switched over to ordinary buss routes, especially with shorter distances to the buss stops. 35% of the travellers are also today sometimes using the ordinary buss routes. The investigation also indicated a larger willingness to pay for the journey. The average price today is about 8,50 NOK. The average willingness to pay contributed 11,50 NOK or about a 35% increase in prices. This is in accordance with experiences from projects in other countries. The cost contribution ratio in these projects are lying clearly over the Norwegian service- and booking routes, but the tickets in the actual projects are lying considerably above the tickets on the ordinary routes. Since the quality is better, the passengers are willing to pay more. In France the booking route in La Rochelle have a ticket price 400% over the ordinary bus ticket and in Germany in Tüblingen the booking route ticket are lying 180% over the price of a trip with the ordinary bus routes (Frøysadal, 1994).

In Norway the number of inhabitants depending on wheelchairs constitute about 0,1% of the population. This is also representative for other countries like Germany, England and Australia (Attorney General's Department, 1998), (Aslaksen, 2000). If this little part of the population should be the reason why choosing to build out an universal buss supply, it would be a very expensive effort in proportion to accuracy to the target group. However there are more people benefiting from the universal organisation, than they who are using wheelchairs. This can be elderly people, people with much luggage or parents with baby carriages. Thus an universal accessible buss supply can be economic defensible.

In regional and long distance buses and trains the problem with accuracy related to the target group are further more current. In these means of transport, other groups in less extent will have effective output from the measures. The accuracy is weak and the costs high. That is one of the reasons why regional and long distance buses are not very well prepared for people with disabilities in any country, besides USA (Attorney General's Department, 1998), (Aslaksen, 2000). However implementing accessibility equipment on new investments will be a different matter. Consequently in the long run, by new investments, the public transport can be adjusted to universal accessibility in a cost-effective way.

A differentiated acting public transport system where ordinary buss routes, service routes, booking routes, the AT-system and taxis are seen as complemented goods in a total transport market, can give people with disabilities better transport standard for lower costs. To get this whole transport system working in an cost-effective way, it requires knowledge, planning, coordination and marketing.

1.4 What does it cost to get universal access to public transport for people with disabilities in Norway?

Table 3 summarises costs of making public transport accessible for people with disabilities before 2012.

Kind of transportation	Total cost (mill NOK)	Cost per year (mill NOK)
Buses – local traffic	1.670,0	152,0
Bus stops	1.000,0	91,0
Buses – long distance traffic	250,0	23,0
Buses – regional traffic	1700,0	155,0
Trains – long distance traffic	16,0	1,5
Trains – regional traffic	28,0	2,5
Trains – local traffic	53,0	4,8
The airport express train	2,5	0,2
Railway infrastructure	1.150,0	104,5
Aviation (airports)	7,0	0,6
Ferries	136,0	12,4
Total cost	**6.012,5**	**546,6**

Table 3: Costs by doing public transport accessible for people with disabilities within 2012.

The total cost of making the public transport accessible for people with disabilities seems to be about 6,0 billion NOK or about 550 mill NOK per year. However there are uncertainty connected to our calculations.

The real cost of making buses accessible for functionally disabled people may be lower than our calculations. There is reason to believe that low floor buses in the future will be standardised. This will remove the price gap between high floor and low floor buses . There are many solutions to get the buses more accessible for people with disabilities. One solution is to modify the bus stops by building them higher. Another effort is to put wheelchair lifts or manual or electric ramps on the buses. If the cheapest solution as far as possible is selected, the cost will be considerably reduced. We estimate that the costs connected to public local route buses in that way can be reduced with about 450 mill NOK or about 40 mill NOK per year. If we cut the costs associated with modified bus stops by 50%, 500 mill NOK or 45 mill NOK per year can be saved.

In many cases spending resources on more selective efforts for instance adjusted service routes or other organised door to door transport, can be more cost-effective and give a higher benefit to the people with the strongest disabilities. However, a prerequisite is sufficient capacity related to route frequency and specialised coaches offered. Very often there are long waiting time for the users of such selective arrangements. Because the value of time is the largest unit in CBA, we'll recommend more effort here.

The costs related to trains can be considerably higher. The Norwegian Railway company (NSB) means that full accessibility for people with disabilities will cost 500-600 mill NOK per year, if the claim are to be met within 2012. The cost figured in table 3 is based on unit costs from an investigation in Australia (Attorney General's Department, 1998). This prices principally are based on reconstruction of old carriages. The assumption is that at least one carriage in every train shall be accessible. NSB means that full accessibility will require replacing all old material. To meet such an investment program, we have estimated a cost of 7,5 billion NOK. That means a cost of 680 mill NOK per year within 2012.

Replacing all the Norwegian old ferries, which are not accessible for functionally disabled people, will cost about 13,6 billion NOK. That means a cost of 1,2 billion NOK per year within 2012.

If we take in account replacing all trains and ferries, and the reduction of costs in the local public route buses, the total cost of making public transport fully accessible for people with disabilities will constitute about 26 billion NOK or about 2,4 billion NOK per year within 2012. However it isn't correct to put all these costs on the demand for accessible transport, because the transport material would have been replaced anyway.

The costs summarised in table 3, shows the extra costs related to the claim of accessibility. If we are setting a claim of full replacement of old equipment, we shall only take into account the difference in present value by speeding up the investment process . However these extra costs are complicated to find, because we haven't any reference course to compare with, i.e. we don't know when the investment would have come if the claim of accessibility wasn't set. With a discount rate on 6% and if the investment have do be done within a period of 10 years, the present value by replacing old ferries and trains will be about 16,5 billion NOK, while within a period of 30 years the present value will be 9,7 billion NOK. Accordingly the difference in present value will be about 6,8 billion NOK by pushing the investment 20 years forward in time. Postponing of the investment can also contribute to saving costs by less pressure in the market.

It will be cheaper to define standards on transport equipment and infrastructure ex ante than repairing and modifying ex post. When a claim is settled, the suppliers of new material will standardise the products. In that way the claims are met. Of course, the prices will reflect such an adjustment, but the rise in prices will not be as high as the rise in costs by modifying and/or reconstructing old material and infrastructure.

1.5 Benefit from increased employment among people with disabilities

As earlier mentioned, the benefit by doing public transport accessible for people with disabilities is methodical difficult to measure. That's the reason why we have not tried to measure the utility created by implementing the measures presented in this paper. However, we have tried to estimate the value of improved public transport to the disabled by making calculations referring to more people being able to take part in labour. We assume that 6-7% of the population under the age of 65, have difficulties by moving and 2-3% can not use public transport because the distance to bus stops is an absolute hindrance. This means that about 4% of the population with disabilities under 65 will be actually users of public transport. We also assume that people under 20 are not prepared for the labour market. This gives us about 100.000 people in our selection. If 5% of this group can get a job, there will be 5000 new wage earners. If there are scarcity in capacity for work in the labour market, the value of this labour force shall be counted as the average wage including all the taxes the company is paying. This will be about 300.000 NOK per employee. In addition the social economic loss by bringing the national insurance outlay in through taxes and the social economic benefit by increased tax income from people who earlier had national insurance, shall be counted for. Together this will be about 50.000 NOK. The total benefit from 5% increased employment among people with disabilities will then be 1,75 billions NOK. With every percent the labour force are increasing among people with functional disabilities, there will be gains about 350 mill NOK.

1.6 Summary/conclusion

Our theoretical discussion show some of the difficulties by traditional CBA analysis in measuring consequences for people with disabilities. Economical analysis of these measures should rather have focus on standard claims, that we try to cover in the most cost-effective way. Therefore, we have not tried to calculate the social benefit from accessibility efforts (besides some simple calculations on local route buses), but concentrated the economical analysis on the costs.

A differentiated acting public transport system where ordinary buss routes, service routes, booking routes, the AT-system and taxis are seen as complemented goods in a total transport market, can give people with disabilities better transport standard for lower costs. To get this whole transport system working in an cost-effective way, it requires knowledge, planning, coordination and marketing.

The costs of implementing the measures on the ordinary public transport supply seem to be very high. Especially if the goal of full accessibility should be satisfied. In the transport sector this means replacing all old equipment. That means an investment program on about 26 billion NOK. However it isn’t correct to ascribe all these costs on the demand for accessible transport, because the transport material would have been replaced anyway. It is only the difference in present value by speeding up the investment process that shall be measured in the CBA analysis. However this extra costs are complicated to find, because we haven’t any reference course to compare with, i.e. we don’t know when the investment would have come if the claim of accessibility wasn’t set. The difference in present value by replacing old ferries and trains over a period of 10 years instead of a period of 30 years will constitute about 6,8 billion NOK. If we only try to calculate the extra costs by doing the public transport accessible for people with disabilities, the total cost will be about 6 billion NOK (table 3). This involves for instance modifying the existing trains and ferries and replacing all the high floor local route buses with low floor buses.

It is cheaper to implement accessibility measures by new investments, than modifying and/or reconstructing old equipment. Therefore it should be set regulations and laws that put claims on new equipment (ex ante). Then the suppliers of new material will standardise the products. In that way the claims will be met. The prices will reflect such an adjustment. However the rise in prices will not be as high as the rise in costs by modifying old material and infrastructure. In many cases only marginal extra costs will occur by following the claims in new investments.

The conclusion must be that with universal accessibility measures, it is most cost-effective to introduce standard claims on new investments ex ante. A justice claim that all public transport should be fully accessible within a short period, will be disproportionately expensive. Even if the measures can be well founded in a Rawls justice perspective (Rawls, 1971), it would be too costly to modify or alter ex post to justify the costs. On the other hand, one can justify putting claim on new investments , since this marginally will compete with other posts in the new investment project. Consequently, it will be at first in the long run, by new investments, that public transport can be adjusted to universal accessibility in a cost-effective way.

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