Upgrading existing buildings to universal design. What cost-benefit analyses can tell us

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Abstract. This article is based on a project aimed at finding the benefits of different measures to upgrade existing public buildings and outdoor areas to be accessible for all [1]. The study was initiated by The Ministry of Children and Equality. The ministry asked for a study of benefits based on a stated preferences (SP) method and an easy-to-complete calculation tool for CBA.

In the project 18 commonly used measures and their typical costs were identified. The benefits of each measure were analysed in a stated preference study. The SP analyses included 9 multiple choices in 4 different sequences in an internet based survey with 800 respondents. The project concluded that it is possible to use stated preferences survey to identify the respondent's valuation of measures to improve accessibility in existing buildings. Some of the measures have a high cost-/benefit ratio.

The project report including the calculation manual is based on the average valuation for each measure. But in the background analyses (not referred in the report) there are also some analyses of valuations for target groups for the various measures. The target groups were defined for each measure based on information about the respondents' abilities and use of technical aids.

The analyses presented in this paper indicate how valuation varies between the target groups and the average population. This is named the measures *profile.* Some measures have benefits for the target group that are only twice as high as for the average citizen while another type of measures has high benefits only the target group. The first type which has a wide profile often has high overall socioeconomic benefits, while the last group with a narrow profile more often has low overall socioeconomic benefits, but may be very important for certain user groups and therefore essential for the elimination of discrimination and exclusion of those groups.

Keywords. Universal design, cost-benefit analyses, stated preferences, existing buildings

1. Introduction

1.1. Background

There are about 146 000 public buildings in Norway, including schools, libraries, universities, buildings for local and national public bodies, stores, hospitals, cinemas etc. Except for the newest buildings, most of those are not fully accessible for all visitors, such as visitors with reduced mobility or vision impairments.

1.5 percent of the existing public buildings are replaced with new buildings yearly and a similar number is renewed [2]. All in all, it will take decades before all existing buildings are replaced or renewed at this low renewal rate. A considerable improvement in accessibility and can only be reached by targeted upgrading of existing buildings. Special accessibility measures are needed to make existing buildings and outdoor areas accessible for all. These are measures like removing steps in entrances, improving lighting, installing lifts, changing to good handrails in stairs, improving visual markings for easier orientation etc.

Better access to buildings and outdoor areas for all citizens is a key element to fulfil the vision of an accessible society. Visiting these buildings is a part of people's everyday life, and the reduced accessibility is one of the major challenges related to the goal of an inclusive society.

There has been some debate about the size of the total costs, but there is no doubt that the measures to achieve accessibility in the existing buildings may require considerable economical resources. These costs have been calculated in several reports, such as [3]. Medby (2007).

This situation calls for cost-benefit analysis. Such analyses are needed to prioritise the various possible accessibility measures for each facility and to prioritise which buildings should be upgraded first. Such analyses may also be useful to describe the overall socioeconomic benefits of measures in this sector and provide a basis for the overall prioritising of resources in the public sectors.

Furthermore, when benefits are identified, there should also to be an easy to use tool to make it easy for the practitioners to present cost-benefit analysis as a part of local action plans, etc.

1.2. Project report 2012

This is the background for a project initiated 2011 by the Norwegian Ministry of Children, Equality and Social Inclusion. The ministry asked for a CBA-study based on stated preferences survey, and the objectives were to:

- Find benefits for different universal design measures.
- Develop a report designed as a cost-/benefit analyses manual for practitioners based on the results.

It was a prerequisite given by the ministry in the call for tender for this project that the study of benefits should be based on Stated Preferences analysis (SP-analysis) and that the respondents should be representative for the total Norwegian population regarding age, gender etc.

The project was finalised in 2012.

The report concluded that it is possible to use stated preferences survey to identify the respondent's valuation of measures to improve accessibility in existing buildings. 18 of the most common measures were analysed and some of the measures had a high cost-/benefit ratio. The benefits presented in the report are benefits per user for an average user.

Based on the results a report designed as a CBA-manual for practitioners were developed.

1.3. New analyses

The project report including the calculation manual describes the valuation of each measure for an average citizen. But in the background analyses (not referred in the report) there are also some analyses of valuations only within the target groups for the various measures.

The results of these analyses indicate to what extent there are benefits for all users, or if there are benefits only for the target groups. Both can be important and both can be reasons to prioritize the measures.

As a member of the project team I have had access to these background analyses. These analyses describe the importance of the assessed measures for the target groups and may give a deeper understanding of the measures. It is often said that universal design is good for all users and highly needed for certain groups. These analyses can support and quantify these considerations.

In this paper I will therefore present some of these results and discuss how they can improve our understanding of universal design measures we use to upgrade existing buildings.

I will first refer the report and the results that are presented earlier briefly, and then introduce and discuss the additional analyses.

2. Project design

2.1. The benefits should be identified by stated preferences methods

To base the assessments on Stated Preferences analysis (SP-analysis) was a prerequisite given by the ministry in the call for tender for this study.

The method can be described as follows [4].

"The SP method is based on the interviewee making hypothetical choices between different alternatives. We distinguish between three types of SP methods (Sælensminde 1995) [5]:

- Contingent valuation method
- Transfer price method
- Conjoint analyses
  - Stated choice
  - Rank
  - Rate"

In the conjoint analyses a number of goods or services can be evaluated at the same time.

In the stated choices sequences, the respondent can choose between different "packages" where each package contains a number of different characteristics. The choice of package forms the basis for mapping the respondents' priorities.

SP analyses may be useful to identify the preferences of the various consumers for non-market goods such as service quality of public transport and of transport infrastructure, travel time etc. One example is a Norwegian study on minor measures in public transport [6]. In this study the benefits of universal design measures like high curbstone at bus stops, enhanced lighting at bus stops and bus stop shelters were analysed. Few efforts have been made to quantify benefits of universal design in public buildings and outdoor areas.

2.2. The analyses included four steps

The key elements of the analyses were as follows:

1. 18 common measures were identified.
2. Typical costs were identified.
3. Valuations were analysed through SP- methods.
4. The results were transferred to an easy-to-complete spreadsheet where cost/benefits are calculated.

In this study, the cost data and the development of a calculation spreadsheet are based on well-known and commonly used methods. The main challenge was related to the analyses of benefits of the 18 measures.

2.3. The measures to be assessed should be commonly used and easy to include in multi choice sequences

The measures should meet the following requirements:

- They should be commonly used to improve accessibility in existing buildings or outdoor areas.
- The typical costs should be known.
- It should be possible to imagine them as a part of the design of places where it is natural to pay for entrance. This was necessary to make it possible to assess the willingness to pay for the various measures by the SP method.

Furthermore, the measures should be commonly used when public buildings and outdoor areas are upgraded to a higher accessibility level. The measures should also include measures aimed to improve accessibility for various user groups (People with visual impairments, hearing impairments etc.). 18 measures were identified based on a study of measures in the database of measures developed in Statsbygg [1] (www.byggforalle.no) and some other similar projects for counties and municipalities in Norway where members of the project group had been involved.

The 18 measures were:

- Good pedestrian walking surfaces outdoor
- Visual marking of walkways

[1] Statsbygg is a public sector administration company responsible to the Ministry of Local Government and Modernisation (KMD). Statsbygg is the Norwegian government's key advisor in construction and property affairs, building commissioner, property manager and property developer.

- Visual and tactile marking indoors
- Stair handrails
- Automatically opening entrance doors
- Visual contrast on entrance doors
- Access ramps for entrances
- Access ramps in swimming pools
- Access ramps at beaches
- Visual marking of doors and glass walls
- Low counters – accessible for wheelchair users and people of below average height
- Universal designed toilet facilities
- Installing elevators
- Modernization of existing elevators – tactile buttons, audio messages etc.
- Improved indoor lighting
- Outdoor lighting
- Assistive listening system/hearing loop
- Floor space for wheelchair access

2.4. Cost data were based on the default costs in Statsbygg's databank

The typical costs for measures in buildings were identified based on Statsbygg's database of accessibility projects. The BfA includes assessment and measures to achieve universal design of all Statsbygg's facilities, and there is a calculation tool with default costs (www.byggforalle.no). Costs of the outdoor measures were calculated by the project team. Costs include the initial investment and maintenance, from which an annual cost is calculated. When the results of this project are used, one can easily exchange these typical standard costs with calculations made for the specific project.

2.5. The analyses of benefits were based on a SP-survey

During the autumn of 2011 an internet-based SP-survey in the Norwegian population was carried out. The analysis was based on a little more than 800 answers and the objective was to find benefits for different universal design measures. The respondents were representative for the Norwegian population regarding age, gender etc.

The survey covered three main types of information:

- Information about the respondent's age, gender, physical abilities, place of living etc.
- The respondents view on the importance of each measure.
- Several multiple choice sequences.

The respondent gave information about age, gender, etc. In addition, the respondents were asked some questions about abilities and the use of technical aids. They were also asked if they had close relatives or friends who used some of those aids. The background questions were related to the ability to walk, see, hear, understand etc. and were used to group the respondents in groups one may assume will have a special benefit from particular measures.

The respondents also gave their view on the importance of the 18 measures on a scale from 1 to 6. (This part of the study is not commented in this paper).

The multiple choice sequences included various situations with payment; entering a swimming pool, a theatre or cinema, an amusement park and a museum. One example of such a stated choice is a choice between swimming pool A and swimming pool B:

Table 1 Example of stated choice

Swimming pool A	Swimming pool B
Good pedestrian walking surfaces outdoor	3
Visual marking of walkways	9
Visual and tactile marking indoors	9
Stair handrails	7

In total the survey included 9 choices for each of the four places (swimming pool, cinema, amusement park and museum).

3. Results in the 2012 report

3.1. Analyses of average valuation

The average valuation per visitor is shown in the table below (1 NOK is approximately 0,125 Euro).

Table 2 Average valuations

Measures	Valuation (NOK)
Good pedestrian walking surfaces outdoor	3
Visual marking of walkways	9
Visual and tactile marking indoors	9
Stair handrails	7
Automatically opening entrance doors	1
Visual contrast on entrance doors	0,5
Access ramps for entrances	1
Access ramps in swimming pools	1
Access ramps at beaches	1
Visual marking of doors and glass walls	2
Low counters – accessible for wheelchair users and people of below average height	4
Universal designed toilet facilities	1
Installing elevators	5
Modernisation of existing elevators – tactile buttons, audio messages etc	2
Improved indoor lighting	17
Outdoor lighting	17
Assistive listening system / hearing loop	0,9
Floor space for wheelchair access	0,9

Among the measures with a high benefit one finds:

- Indoor and outdoor lighting

- Visual and tactile markings
- Stair handrails

Also elevators show a high benefit rate per user. This is not surprising, since elevators have always been regarded to be important both for the service level of the building in general, and as an important accessibility element. The high values of visual markings and lighting may look a little more surprising. To go deeper into this, one has to look at the background numbers and the measures *profile* (paragraph 3.3).

3.2. The calculation tool

A calculation tool for practitioners has been developed based on the results from the study. This is an easy to use excel spreadsheet. The number of users shall be filled in. There is one number for the visitors and one for the employees.

The cost of the measure is calculated as an annual cost for a period of years based on the measures' expected life time and includes:

- Investments per measure multiplied by the number of similar measures needed to upgrade the building.
- Annual expected maintenance cost of the measures needed (may be both higher and lower than in a situation with no measures).

This is an example where an automatic opening door to the service centre in the city hall is installed:

The facility is a city hall with a service centre where an automatic door is installed. The centre has 9.000 visitors per year and 3 persons are working in the centre. These numbers are entered in the two first green cells. There is one door to be installed and the number "1" is entered in the third green cell.

The blue (dark) cells contain the proposed or default investment costs and operating and maintenance costs. The door has a life time of 10 years, and it will be financed by public budgets.

The calculation shows that the net present value is positive and that the measure is profitable. Net value per NOK budgeted is 0.24 and this value may be used to compare this effort with other alternatives and gives a basis for prioritising.

Data for all measures

- Length of period to be analysed: 25 years
- Discount rate: 4 %

Basis for the calculation

- Number of visitors per year: 9 000
- Number of employees working in the actual facility:3
- Valuation of the measure - NOK per person per visit: 1

Information about the measure

- Number of installations: 1
- Costs per installations: 40 000
- Yearly operating and maintenance costs: 1 500
- Percentage public funding: 100 %
- Life time of the measure - default for this measure:10 years:10

Table 3 Example

Present value of benefits	**145 473**
Present value of all costs	**121 451**
Present value of investment costs	77 776
Present value of operating and maintenance costs	23 433
Taxation costs	20 242
Net present value	**24 022**
Net present value per NOK budgeted	**0.24**

4. Additional analyses of the measures profiles

The project report including the calculation manual is based on the average valuation for each measure. But in the background analyses (not referred in the report) there are also some analyses of valuations for target groups for the various measures.

The results of these analyses indicate to what extent there are benefits for all users, or if there are benefits only for certain user groups. Both can be important and both can be reasons to prioritize measures. The examples in the table below illustrate some interesting facts about the various measures.

Table 4 Average valuations and valuations from target groups

Measures	**Valuation (NOK)**	
	Average	**Target group**
Good pedestrian walking surfaces outdoor	3	9
Stair handrails	7	33
Installing elevators	5	51
Improved indoor lighting	17	32
Outdoor lighting	17	32
Assistive listening system / hearing loop	0,9	89
Floor space for wheelchair access	0,9	19

Indoor and outdoor lighting gets high average scores because many respondents give this measure a positive valuation. The score from the target group is only twice as high as the average. This means that none of the respondents valuate this measure extremely high, but it gets a high score because many of the respondents appreciate this measure. The benefit profile is *wide*.

Hearing loops is an example with an opposite profile – a *narrow* profile. The average valuation of this measure is very low, but the valuation from the target group is among the highest. The average is NOK 0.9 per respondent, while the valuation from the target group is NOK 89 per respondent. This is of course because you have to be in the target group and use a hearing aid to be able to use this equipment. If you do not have a hearing aid, you will not notice it at all and it will be of no direct use to you. The benefit profile therefore shows a high benefit for a limited group of users. Enough floor

space for wheelchair access has a similar profile. This is not important if you are not a wheelchair user.

Most of the measures have a profile between these wide/narrow examples. This means that there often are some benefits for all users, but also that the benefits for the users in the target group is much higher than the average. Many respondents value good surfaces for walking, but those who have some problems with walking value good surfaces three times higher. Many respondents value good handrails, but these are three times more important for people with walking problems and people with seeing impairments (handrails can help people find their way). Elevators are naturally extremely important for people who cannot walk in stairs, but many users value the presence of elevators to some extent.

5. Discussion

5.1. Howe can cost/benefit analyses support the planning and implementation of measures to make public buildings usable for all visitors

In the project 18 measures were analysed. The project shows that benefits of measures to improve accessibility in existing buildings can be identified by using Stated Preferences analyses and cost/benefit data can be calculated and used in socioeconomic analyses to support prioritising within the sector and between sectors.

Some of the measures have a high c/b ratio. As an example easy to grip handrails in stairs may pay back six times the investment. This is extremely profitable and will be positive even if the costs are much higher than the average costs that are used in the example. Universal design measures to improve public buildings accessibility should be competitive with a lot of other common public investments.

The measures may have a wide or a narrow profile. The profile is wide when the measure benefits many users also outside the measure's target group, and a narrow profile when it is only the target group who benefits.

But the prioritizing should not be based only on the total c/b ratio. On should look at the measures profile and prioritize measures with low total benefits for the total population if they are highly valuated in one target group. Such measures may reduce exclusion and discrimination. One should both implement measures with high overall benefit, and measures with lower overall benefit if they are essential for particular groups of the population. Therefor the focus should still be to reduce exclusion, but the c/b analyses can support the analyses and give a basis for select the best measures both for the target groups and for the population as a whole when measures are decided.

One effect may be that more measures that have been regarded as less important may be implemented because the benefit may people, although the benefit for each person may be low. As an example measures like improved lighting have a wide profile and may seem underestimated. The results show that such measures should be prioritized. By using the projects results and calculation tool in prioritising, more emphasis will be put on measures that improve the buildings' quality for a wide audience. Such measures may easily be forgotten if one only focusses on the most obvious deficits.

By using the cost/benefit analyses it seems that measures related to low vision may be more emphasised.

In this project, the main focus was on the average values, and the use of those as input to the calculation tool. But the results show several interesting "mechanisms" related to how the measures may benefit various users. These may be used in the prioritizing and the selection of measures, and may clarify what kind of benefits one can expect. There may also be more consciousness about which kind of benefits one tries to achieve by the various measures.

5.2. Some effects may not be covered by the survey

When using the results, one has to take notice of:

- There may be effects with no associated price. These are not covered by the survey.
- There may be a package effect.
- The benefits for customers and employees in the building should be calculated separately.

The package effect may occur if we look at the effect of several measures in combination. The same benefits should not be counted twice (or more). Some of the measures may also depend on each other, like an accessible entrance and an accessible lift. For some users both must be present to make the building accessible.

Customers and employees may use the building in a different way, and use different parts of the building. Hence, the total costs of improving certain attributes may be different.

References

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