

Ex post evaluation of transport projects – experiences from Norway

Morten Welde; Norwegian University of Science and Technology; Concept Research Programme; 7491
Trondheim; Norway

Gro Holst Volden; SINTEF; 7465 Trondheim; Norway

Abstract: Huge resources are used on transport investments annually and decision makers rely on comprehensive appraisals before making their investment decisions. However, the amount of resources used for ex ante appraisal is rarely matched by the resources used for ex post evaluations. This paper presents an evaluation methodology that has been tested on five transport projects in Norway. The purpose of the paper is to demonstrate that ex post evaluation needs to take a broader perspective than the traditional economic appraisal provided by the Cost-Benefit Analysis. The evaluation framework presented in the paper is based on a combination of a goal oriented methodology and a more traditional economic analysis. Thus far, the experience is positive, and the combined methodology works well as a broad foundation for evaluation of large transport investment projects. The methodology forces evaluators to shift their focus from first order effects to the overarching and important long-term issues such as wider economic benefits, regional development effects or sustainable development. The results suggest that it is in these areas that effects are still limited and the need to learn is greatest. We believe that evaluating a large number of projects based on this methodological framework will make it possible to learn about project success on several levels, to draw lessons across projects, and ultimately to improve and broaden existing appraisal methodologies.

1. Introduction

Governments throughout the world use large resources on planning and implementing transport infrastructure investments. In Norway the annual budgets for transport investments have increased considerably over the last decade and the current government have signalled that spending will increase further. Substantial resources are also devoted to improving appraisal methods (cost estimation techniques, transport models, consumers' valuation of the effects, etc.) and there are national guidelines in most countries concerning Cost-Benefit Analysis. Ironically, the amount of resources used for ex ante evaluation is rarely matched by the resources used for ex post evaluations.

Ex post evaluation is often considered to be the weak link in the planning, implementation and operation of transport infrastructure investments and regulations. The assessment methods have tended to rely on ex-ante appraisal, making predictions of how a scheme or policy might perform rather than being based directly on the outcomes of past decisions (Worsley, 2014).

Ex post evaluation can serve multiple purposes, where learning/ improvement and accountability/control are the two primary purposes. Our focus is on the former. An overall purpose is to improve future policy, programmes and projects through feedback of the lessons learned. More specifically, the evaluation may be targeted at identifying deviations between forecast and outturn values for specific variables; it could be used for general validation of the ex ante appraisal tools and models; for understanding key relationships; and to learn about factors that determine whether the project is a success or failure.

Another purpose is to determine whether the specific project objectives were delivered or not. Objectives might include economic development, increased productivity, population growth in specific regions,

modal shift, environmental improvements, etc. And of course, investment projects always have goals related to the delivery itself, requiring compliance with budget, deadline and agreed scope and quality. Ex-post evaluation may thus provide a basis for accountability.

This paper presents a broad methodological framework for ex-post evaluation of transport projects, and the results from ex post evaluations of five transport projects using the framework. The work is carried out under the auspices of the Concept Research Programme that is financed by the Norwegian Ministry of Finance to do trailing research on large public investment projects in sectors such as transport, defence, public buildings, sports events and major ICT projects. The goal is to attain better use of resources and greater effects of investments. An important part of the programme's activity is to perform ex post evaluations of projects. The suggested methodological framework includes six evaluation criteria which together ensure that a broad perspective on the project is taken.

The paper proceeds as follows. In Section 2 we review existing literature on the most widely used appraisal methods in the transport sector, their strengths and weaknesses, especially regarding their use in ex-post evaluation; In section 3 we discuss the need for a broader evaluation framework to cover more relevant perspectives and present the evaluation framework suggested in this paper; Section 4 presents the evaluated projects and the results of the evaluations; and in Section 5 we offer some conclusions.

2. Literature review

The appraisal of transport projects usually includes an investigation of opportunities, an alignment of needs with goals, the estimation of costs and benefits of relevant solutions, and a ranking of solutions in order to try and achieve long-term strategic success. The success criterion used is normally an economic one such as Net Present Value, internal rate of return or the benefit/cost ratio. It is a time-consuming process which involves extensive consultations and may include multiple actors at different levels of government. Despite this broad planning perspective, it is the Cost-Benefit analysis (CBA) that traditionally has attracted the most attention throughout both the ex ante and the ex post evaluation process.

In the transport sector there is a long tradition for the use of CBA to inform decision makers about projects' economic profitability ex ante. The CBA framework allows us to measure different effects on different actors and to summarise them quantitatively – usually in terms of money. Increasingly complex transport models are used to simulate first order effects of a new project or scheme in the transport markets. In CBA the idea is to determine relative weights of different kinds of benefits through citizens' own preferences, as opposed to decision-maker or planners' own preferences (Eliasson, 2014). Although increasingly common throughout the public sector in many countries, it is particularly well suited for and common in the transport sector. This is because transport investments usually have many kinds of effects that can be measured in monetary terms, such as changes in travel time, travel costs and patterns, emission, noise, safety etc., and also because the political goals set for transport project are often related to economic development and therefore correspond well with the effects covered by the CBA.

CBA results are often questioned as they may be dependent on uncertain assumptions about the future and on methodologically uncertain valuations of costs and benefits (Börjesson et al., 2014a). An often quoted study is that of Mackie and Preston (1998) who listed twenty-one sources of error and bias in appraisal. They concluded that appraisal optimism was the greatest danger in transport investment analysis. Appraisal optimism happens because scheme promoters may – deliberately or unwittingly – bias the appraisal. A more recent study on the state of the art in appraisal and its main challenges is Mackie et al. (2014) who discussed the main challenges in the appraisal of transport projects albeit focusing on the benefit side of the analyses. In the following we discuss a few of these challenges.

One of the main reasons how bias could enter the appraisal is through the traffic forecasts. If real traffic levels deviates significantly from forecasts, this will ultimately affect the estimated economic benefits and, potentially, the ranking of projects. The consequences of inaccurate traffic forecasts depend on the context within which the new facility is built. In uncongested conditions, underestimated traffic will imply underestimated economic benefits. If congestion is or will be a problem during the appraisal period, underestimated traffic may imply a shorter period of relief from congestion and hence an overestimation of benefits. Despite the crucial role of traffic forecasts, data limitations have made ex post studies relatively rare. In a review of the existing literature, Nicolaisen and Driscoll (2014) surveyed 12 studies of road and rail projects from the 1970s to the present. They found that the mean inaccuracy for road projects was typically positive, indicating that more demand than expected materialised after the projects have been completed. Most results lied within the span of 3–11% additional traffic compared to forecasts. The mean inaccuracy for rail projects, on the other hand, was negative. Most results lied within the span of 16–44% less patronage compared to forecasts. This is similar to other user-financed projects such as toll road projects which generally experience demand shortfalls compared to forecasts. The authors concluded that the relatively large range within which traffic forecasts fall represents a challenge for the use of travel demand forecasts as decision support.

One of the main challenges in appraisal and project implementation is that the effects of a scheme are not known in detail before years into the future. This is particularly the case for land use effects which for practical reasons is largely ignored in most appraisals. Börjesson et al. (2014b) studied how omitted demand due to ignored land use effects impacted on CBA outcomes for projects in the Stockholm region in Sweden. They found that the effect on relative ranking of projects was limited and concluded that the CBA rankings were robust to uncertainties regarding future land use impacts. Others, such as Næss et al. (2012) argued that the omission of induced traffic and its long-term effect on land use and the quality of public transport services, can lead to serious bias in the assessment of environmental impacts as well as economic viability of road projects.

An issue which has attracted increasing attention since the millennium is the so called wider economic benefits of transport schemes. Since the influential SACTRA report “Transport and the Economy” (1999) increased attention has been given to market imperfections which may cause the full benefits of a transport investment not being captured by the CBA. Several case studies (see, e.g., Venables, 2007; Vickerman, 2008; Graham, 2009) have since tried to estimate the wider economic benefits of transport schemes and concluded that in some cases there is additionality to the direct benefits but that these are context specific and not relevant in all transport projects. Many of the recent advances in the development of methodologies for quantifying these effects were developed through the Crossrail project in London. There it was found that including the wider benefits from the scheme increased the benefit cost ratio from 50-100% depending on the values of time applied (Crossrail, 2010). Wider benefits are, however, not restricted to urban areas. In a study of four road projects in rural areas in Scotland, Laird and Mackie (2014) found the additional welfare benefits due to wider benefits to vary from almost zero to formidable 64%. They concluded that wider economic benefits are relevant to transport project appraisal and that omitting these could potentially bias the appraisal in that their exclusion may alter project ranking in an investment programme.

One might think that ex post evaluation, in terms of verifying the CBA conducted ex ante, is a far more straightforward exercise than appraisal. Experience shows that this is not necessarily the case. A serious challenge is the lack of data. Another is that other changes have normally happened to the location in the meantime, making it difficult to ascertain the net contribution of a project. The result is that few ex post evaluations are conducted, and when conducted they often take a narrow perspective – even effects that

was quantified and valued in the appraisal, based on model simulations, cannot be captured in a satisfactory manner ex post.

Whereas ex post analysis of benefits rely strongly of the traffic forecasts which again rely on physical road side equipment being installed to measure the level of traffic post opening of the facility, the costs are usually more readily available. The investment cost is typically the parameter which attracts the most attention throughout both the appraisal and the implementation phase of projects. Cost overruns, i.e. unexpected costs incurred in excess of budgeted amounts, have attracted increased attention over the last decades and are the source of much public debate. The literature on cost overruns is growing. Odeck (2014) reviewed 20 studies from all continents of the world and found cost overruns to be prevalent in road projects. The range of overruns varied from modest overruns in the order of 5-10% to over 40%. All other things being equal, this will have reduced the net benefits from the projects being studied. The effects of cost overruns may be detrimental to economic efficiency and may lead to the wrong projects being implemented. But as suggested by Williams and Samset (2010) cost overruns during the implementation phase may sometimes only comprise a fraction of lifetime benefits. Another challenge that has received much less attention is that the increase in cost estimates during the appraisal phase, i.e. before the decision to build is taken, may be much larger than the subsequent overrun during the implementation phase (Welde and Odeck, 2014).

Comprehensive ex post analyses of transport projects are rare. A noticeable exception is the Post Opening Project Evaluation (POPE) of the UK Highways Agency (HA) which are undertaken for all of the HA's major schemes. The key objective of POPE is to identify the extent to which the expected impacts of highway schemes have materialised and to inform thinking on current and future national scheme appraisal methods. POPE also measures whether schemes have offered value for money, i.e. positive net present values, and the level of accuracy associated with estimates of costs and benefits. POPE studies are undertaken for each Major Scheme one year and five years after opening. The latest summary report (Highways Agency, 2013) showed that 94% of schemes achieved their objectives. Most schemes, 72%, offered high value for money and 85% achieved medium or high value for money. Forecasts were accurate – a majority (65%) of the schemes accurately forecasted traffic flows (within +/- 15%) and half of the schemes had costs in the appraisal within +/- 15% of outturn costs. In addition to the ex post evaluations carried out by the Highways Agency themselves, UK transport projects are also subjected to external scrutiny by the National Audit Office who does annual value-for-money studies across a range of government activities. The work is not strictly ex-post and assessments are regularly carried out prior to implementation. The reports look at how government projects, programmes and initiatives have been implemented and make recommendations on how it can be improved (Barker et al., 2014).

Similar to the UK approach is the ex-post CBA of road projects in Norway. In a formalised framework for ex post evaluation 3-5 road projects are evaluated annually. The purpose is to verify whether the estimated costs and benefits deviate from real outcomes. So far results indicate that the original CBAs have been based on conservative estimates as 15 out of 20 projects showed an improvement in net present values as compared to the original analyses. The main reason for this was found to be higher traffic growth than forecasted; in fact, traffic levels were higher than forecasts in 19 out of 20 projects. This may be explained by the booming Norwegian economy since the millennium. As for construction costs, it was found that half the projects were completed with lower costs than estimated; a majority of the projects had cost estimates within +/- 15% of real costs. Odeck (2012) thus concluded that the CBAs presented to decision makers were not over-optimistic but rather erred on the pessimistic side. The end result could be that viable projects are postponed or rejected unnecessarily.

Another country worth mentioning is France that has a long tradition of setting up observatories for collecting data to facilitate a detailed evaluation of major transport schemes (Bonnafoous, 2014). Key

indicators of ex-post performance is set out, including data on actual and forecast costs, patronage, road traffic volumes, etc. An estimate of the predicted and actual economic internal rate of return for the investment is provided. In addition, an assessment of the causes of any observed differences between forecast and outturn values is included, as a means of informing analysts about potential improvements to appraisal methods. This has greatly improved the quality and coverage of data on major transport schemes in France, especially in cases where an observatory is set up already at the time of project approval, so as to ensure that the “before” conditions are recorded. Through a systematic and timely monitoring process, one also ensures that data that changes frequently and is available for only a short time (such as fares) is collected.

3. More comprehensive evaluation is needed

The weaknesses of CBA discussed in the previous section provide in themselves a clear motivation for carrying out ex post evaluation studies, the purpose being to improve existing methods of appraisal. In our opinion, the ex post evaluation should take a broader perspective than merely measuring the net present value. All changes that can be attributed to the project may be of interest, and the evaluation should explain why these changes happen, or why they do not happen as anticipated. Furthermore, the additional challenges related to ex-post evaluation demonstrate that ex post evaluation needs planning in advance in order to obtain the data necessary for evaluation.

Evaluation is aimed at measuring the success of projects. Success is, however, a highly aggregated parameter. There are large variations in how it is defined and interpreted. An engineer might view a project which has delivered on time and budget as a success. An economist might focus on the estimated costs and benefits as included in the CBA. The financing party normally wishes to establish whether the agreed project objectives – whatever they are – have been reached or not. Users will be concerned with the benefits to themselves. Environmental organizations will ask about the environmental consequences. Policy-makers may be concerned about the local and regional economic development impacts (jobs created), etc. Major infrastructure projects should thus be evaluated from a wide social perspective including all the above-mentioned parameters.

It could be argued that the most important effects in a transport project are quantified and included in the CBA and that the most appropriate measure of success would be an ex post CBA. However, this is only true if one accepts the normative premise that impacts should be weighted according to people’s willingness to pay, implying for example that time savings are worth more when they accrue to airline passengers than to bus passengers simply because the former group is more wealthy, and that future generations are disregarded due to discounting. See for example Heinzerling and Ackerman (2002) for general critique against CBA as a measure of improvement in social welfare. Several studies have shown that CBA results seem to have little or no impact on project selection, even in countries claiming to put a large weight on appraisal results (Jansson and Nilsson 1989; Nilsson 1991; Fridstrøm and Elvik 1997; Odeck 1996, 2010; Nyborg 1998; Nellthorp and Mackie 2000). An exception was found for the Swedish Transport Investment Plan 2010-2021 where CBA results were found to have affected project selection (Eliasson et al. 2014). That doesn’t mean that CBA is irrelevant or that the analyses don’t include important effects. It does, however, clearly show that decision makers consider other effects than just the monetised effects and that projects which are unprofitable from an economic perspective might be desirable as long as it delivers other objectives. In other words, economic profitability might be a too narrow measure of project success.

A high proportion of Norwegian road projects have always produced negative net present values. There are a number of reasons for this. Firstly, Norway is a country where road construction may be difficult and expensive due to the geographic conditions and the low population density – tunnels, bridges and

roads in mountainous regions are costly to build. Secondly, there is a broad consensus that maintaining the settlement pattern is desirable – most of the natural resources (fish, oil, timber etc.) are located in rural areas. And thirdly, rural areas are over-represented in the Norwegian parliament compared to urban areas. This malapportionment is likely to have assisted in the adoption of regional development policies aimed at improving the road network in areas with low levels of traffic. Conversely the under-representation of the densely populated Oslo region is likely to have been one reason for the delayed adoption of policies related to urban problems. Bus operating subsidies for example, were denied to Oslo and Bergen until 1973 (Knowles, 1981). This means that the political objectives for a high number of investment decisions have been to benefit one specific region. Thus, even if a project has a negative net present value it might be successful from a political perspective if it has attained, say, distributional objectives.

A final reason why a high proportion of road projects have failed to produce positive net present values is the traditionally conservative estimates set by the Ministry of Finance and used in the CBAs. From the 1970s when CBA first was adapted a discount rate of 7 percent and an appraisal period of 25 years were applied. At the millennium, the discount rate was increased further to 8 percent. This sparked an outcry not just from road user alliances and politicians but also from professionals who considered the arguments for a high discount rate to be flawed and unfounded in economic theory. The implication was of course that CBAs was seen to be of little value because a majority of the analyses produced negative net present values. It is not until recently that road and rail CBAs have been based on assumptions closer to the appraisal practices of other European countries. Currently a discount rate of 4 percent is used in all transport projects and the appraisal period is 40 and 75 years for road and rail respectively. It is too early to say whether the increased share of economically viable projects that the new practice inevitably will imply will increase the importance of the net present value as a decision criterion.

In order to capture a broader range of issues relevant in the decision making process, the Concept Research Programme has suggested a framework for ex-post evaluation that focuses on social benefits in several perspectives. This is a broader approach than conventional appraisal based on economic profitability alone. The evaluation framework consists of six evaluation criteria which together ensure a broad perspective. This includes the operational perspective, the tactical perspective, and the strategic perspective.

The methodological framework is presented briefly in the following (see Volden and Samset (2013) and Samset (2003) for a more detailed presentation). Five of the six criteria are based on a goal-oriented methodology, evaluating the project and its effects against well-defined delivery plans focusing on the output, projects goals specifying the desired state that the project is intended to contribute to, and the long-term purpose explaining the rationale behind the investment. A goal oriented methodology is well suited for projects, which by definition are phenomena that are limited in time and scope, and which are well-defined with formally agreed objectives on several levels. The methodology selected is based on a methodology that is widely used in evaluation of development aid projects and programmes (OECD DAC, 1991) and consists of five evaluation criteria: *efficiency*, *effectiveness*, *impacts*, *relevance* and *sustainability*. It is, however, less used in the evaluation of transport projects in developed countries. The framework is generic and therefore applicable to all types of investment projects.

Goal achievement is, however, no measure of success alone. There is of course a limit to how much that can be spent in order to achieve a desired outcome. The five original OECD DAC criteria mentioned above are therefore supplemented with a sixth criterion, economic profitability, which is more or less meant to be an ex-post CBA. This sixth criterion is complementary to the first five. If all kinds of effects were covered in the CBA, and the only political goal was to maximize social welfare as measured by the net aggregate willingness to pay, then it would probably be superfluous to do both. But normally this is not the case, and the two methodologies both provide added value to the evaluation.

Table 1 summarizes the six criteria.

Table 1: Evaluation criteria used in the ex post evaluations

Goal oriented evaluation criteria	Efficiency	Measures operational success: To what degree have the outputs achieved derived from efficient use of financial, human and material resources?
	Effectiveness	Measures tactical success: Were the stated objectives achieved and to what extent did the project contribute to the goal achievement?
	Impact	Measures strategic success: Has the project had any other positive or negative consequences other than those planned?
	Relevance	Measures strategic success: Has the project been in line with the needs and priorities of the owners, the intended users and other affected parties?
	Sustainability	Measures strategic success: Are the positive effects derived from the project likely to continue after the project has been completed?
Socio economic profitability		Has the project delivered a positive net present value?

4. Evaluation results

So far five transport projects have been evaluated by the Concept Research Programme. The projects differ in size and scope but they all have in common that they have been subjected to the quality assurance (QA) scheme for major public investment projects in Norway (described in full in Samset and Volden, 2013). Today, all Norwegian public investment projects, except health projects and projects in the oil and gas industry, and with an expected cost above NOK 750 mill. (\approx \$110 million) must be subjected to QA by external consultants approved by the Ministry of Finance. It is, in other words, part of a standardised governance framework that aims for project success by ensuring quality at entry, i.e., that the grounds for decision making are adequate so that the right projects are selected for implementation. The evaluated projects are presented in Table 2.

Table 2: The evaluated projects

Project name	Type of project	Size		Opening year
		Budget (million NOK ¹)	Length (km)	
Sandvika-Asker	Double track railway	4165	9,5	2005
Momarken-Sekkelsten	Part of a highway	490	6,2	2007
Riksgrensen-Svingenskogen	Bridge and motorway	964	5,0	2005
Eiksundsambandet	Sub-sea road tunnel	1200	13,7	2008
Lofast	New road	1306	29,9	2007

¹ 1 NOK \approx 0.12 EUR as of April 15 2015.

The five ex-post evaluations were conducted by different evaluation teams, all multidisciplinary with experts on evaluation methodology, economics as well as experts within transport interventions.

Efficiency

Efficiency is a measure of the success of the implementation process, i.e. to what degree the outputs achieved derived from efficient use of financial, human and material resources. In principle, it means comparing inputs to outputs (Samset, 2003).

Numerous studies have shown that estimates of construction costs are inaccurate and that a majority of projects end up with costs higher than budgeted. Norway is no exception to the problem of underestimation of costs, but has since the introduction of the QA scheme taken significant steps towards improved estimate accuracy and project management. Samset and Volden (2013) showed that 80% of public sector projects subjected to external QA were completed within budget. Transport projects have shown similar improvements and Odeck et al. (2015) showed that 70% of road projects experienced cost underruns. The ex post evaluations of the five projects in our sample show similar results. Table 3 shows that four out of five projects were completed within the budget of P85.

Table 3: Project efficiency

Project	Price level (year)	Final cost	Final cost / P50	Final cost / P85
Sandvika-Asker	2006	3765	1,05	0,91
Momarken-Sekkelsten	2010	643	1,19	1,07
Riksgrensen-Svingenskogen	2009	897	0,90	0,80
Eiksundsambandet	2009	1062	0,99	0,90
Lofast	2009	1380	1,01	0,89

The P85 level is managed by the ministry while the responsible agency is usually given a budget equal to P50. The P50 is equal to the median and is important on the portfolio level. For the government which can diversify between a large number of projects, half the projects should ideally be completed below and the other half above the median. The sample of evaluated projects is of course too small for this measure to make any sense, but we notice that three of the projects have had final costs below or very close to the P50.

The results regarding time, quality and scope was acceptable in all the five projects.

Effectiveness

Effectiveness is a measure of tactical success, i.e., if the project is managed to achieve its stated objectives. For transport projects typical objectives are usually reduced travel time, improved traffic safety, mitigation of local environmental effects, regeneration of deprived areas etc. Often there are several goals, some of them may be conflicting, and they are not always ranked according to importance. This makes evaluation more challenging. We can see from table 4 that in only one of the projects the goal was stated in terms of the Cost/benefit ratio. More often transport projects are implemented in order to achieve political goals (with more or less impact on profitability) such as reduced travel time, modal shifts or elimination of inconvenience due to ferry service.

Sometimes the objectives may be unambitious (e.g. improve capacity) or too ambitious (typically various measures of economic growth). In several of the evaluations the evaluators thus had to interpret and sometimes reformulate the original objectives; several steering documents didn't include any meaningful objectives besides the construction of a new facility – but in most cases the political discussion leading up to project approval had been based on certain objectives which the project was expected to achieve. Table 4 shows the objectives that the effectiveness of the projects was evaluated against.

Table 4: The objectives of the projects

Project	Objectives
Sandvika-Asker	<ul style="list-style-type: none"> • Improved capacity • Shorter travel time • Increase the modal share of the train • Reduced emissions
Momarken-Sekkelsten	<ul style="list-style-type: none"> • Reduce the number of accidents • Shorter travel time • Reduce emissions and noise • Improve the welfare of local residents
Riksgrensen-Svingenskogen	<ul style="list-style-type: none"> • Cost/benefit ratio equal to at least 1 • Travel time savings 763 million NOK • Safety benefits 306 million NOK
Eiksundsambandet	<ul style="list-style-type: none"> • Reduced travel time • Eliminate inconvenience costs due to ferry service
Lofast	<ul style="list-style-type: none"> • Reduced travel time • Improved transport reliability

Table 5 shows the results of the evaluations.

Table 5: Project effectiveness – results

Project	Results
Sandvika-Asker	Not achieved. Overall, the project has not delivered the planned benefits. The capacity has increased marginally and the reduction in travel time has been negligible. The number of passengers has increased, but this has been organic growth and not due to a modal shift from the private car.
Momarken-Sekkelsten	Achieved. Travel time has been reduced and the number of traffic accidents is halved. Traffic on the local road network has been reduced by 80% with improved air quality and quality of life as a result.
Riksgrensen-Svingenskogen	Achieved. The quantified benefits have been equal to or exceeded the stated objectives. There has been a significant reduction in travel times and the number of and severity of accidents has gone down.
Eiksundsambandet	Achieved. Large reduction in travel time (~30 minutes). The ferry service has been replaced by a fixed link.
Lofast	Achieved. The new road links the Lofoten archipelago to the mainland and businesses and travellers no longer have to rely on an infrequent ferry service.

As is evident from Table 4, many of the objectives of the project were not very ambitious. Objectives such as increased capacity, which is an operational objective rather than an effect of the project and

reduced travel time are normally very easy to achieve. In other words, the chance of success in the projects has been high due to a limited perspective and a low ambition level. On the other hand, there is always a limit to what can be achieved through a medium sized road or rail project.

The project that was not effective in achieving its objective was the new railroad Sandvika-Asker outside Oslo. Even if it was a relatively large project in budget and length, it was only a section of a longer rail line, and worse – the section was (and is) in the middle of the line and it will take improvements at both ends before the planned benefits can be achieved.

An issue for three of the projects has been the Norwegian “tradition” of splitting up road or rail improvements into smaller sections of up to 10 kilometres. This not only makes construction more expensive, but also that benefits will accrue at a later stage than if the larger section was completed. Traditionally this has been due to budget constraints and today, with generous budgets, projects are generally larger than they were a decade ago.

Impacts

While effectiveness is an evaluation criterion that focuses only on specific *positive* and *planned* effects expected to accrue to the involved parties, expressed in terms of the tactical objectives, the concept of *impact* is a far broader one, as it includes both positive and negative consequences, whether they are expected or not. A broad assessment of impacts is essential in a comprehensive evaluation, but is also often the most difficult and demanding part of the evaluation framework (Samset, 2003).

In transport projects, the objectives are normally related to user benefits such as travel time savings and improved traffic safety. These are measured by the *effectiveness* criterion. Examples of other (often indirect) sideeffects or impacts, on the other hand, are changes in land use, more sustainable development, reduced deprivation of urban areas etc. Impacts were usually not planned in advance. The key question is, what positive and negative effects have come about as a result of the project? Table 6 shows the evaluators’ assessment of the impacts of the projects.

Table 6: Project impacts

Project	Result
Sandvika-Asker	No indirect impacts so far.
Momarken-Sekkelsten	Both positive and negative. The project has contributed to a better living environment in the affected area. On the other hand, the road has increased the attractiveness of the private car at the expense of public transport. The train operating company is experiencing reduced passenger levels.
Riksgrensen-Svingenskogen	Largely positive. Whereas the old bridge was considered a bottleneck, the new bridge is now the preferred border crossing to Sweden in this region. Increased pollution due to traffic increase could be considered a negative impact.
Eiksundsambandet	Positive. The tunnel connects two regions – one with a major shipbuilding industry and one with public services (university, hospital, airport). The labour market has increased and become more flexible; the productivity of businesses has improved and there are signs of incipient rationalisation of public services (e.g. shared casualty clinic).
Lofast	Largely positive. The new road has considerably improved the accessibility to and from the Lofoten archipelago. Tourists may visit the area in less time. This is, however, a negative impact for the local tourist industry, but which is compensated for by increased number of tourists. The project had a negative impact on the landscape; it crossed a virgin natural area – part of which has since been declared a natural park.

The evaluations have demonstrated that there are both positive and negative impacts from transport projects. In order to achieve any significant wider benefits the project should deliver large travel time savings and connect labour markets. If not, additional positive impacts are likely to be minor.

Relevance

Relevance is a measure of strategic success and whether the project is in line with the needs and priorities of the owners, the users and other affected parties. Many transport projects might be part of a larger strategy to improve accessibility and growth in an area, but the individual project may be a necessary but not sufficient instrument in order to achieve the desired long term benefits.

Table 7: Project relevance

Project	Result
Sandvika-Asker	Good. There is a need to expand rail capacity into Oslo. But capacity should rather have been added from Oslo than from the outer edge of the rail line. The project has so far been unsuccessful as a measure to reduce road traffic growth.
Momarken-Sekkelsten	Good. The new road replaced a single carriageway plagued by accidents. There was clearly a need for the new road, but the implementation strategy of dividing the project in many smaller sections has been less productive.
Riksgrensen-Svingenskogen	Good. As for Momarken-Sekkelsten, the project was part of a strategy to improve the trunk road network through Østfold county and into Sweden.
Eiksundsambandet	Good. Industries along the coast provide huge export revenues from Norway, but to ensure robustness in labour markets there is a need for infrastructure to link smaller sub-regions. Eiksundsambandet fits well within that strategy. Traffic levels have been much higher than forecasted; the users appreciate the flexibility that the tunnel provides and there has been an increase in the population of the area.
Lofast	Uncertain. There was a need to link Lofoten to the mainland and improve communications for the some 30.000 inhabitants. However, an alternative route, a tunnel which would have linked Lofoten to both the neighbouring area of Vesterålen as well as the mainland would probably have been a better option to the region as whole and not just Lofoten.

The evaluations have shown that the projects have largely been relevant, but an issue worth considering is the desire to benefit one specific region through large public investment projects. This not only leads to projects unviable in economic terms being implemented but also to poor project alternatives being selected. The Lofast case shows that an alternative route would have been more beneficial to society even if travel times from Lofoten and to national and international markets would have been marginally higher.

Sustainability

The issue of sustainability goes beyond the project itself and is an indication of whether the positive effects are likely to continue after the project has been completed. This may depend on the financial viability of a project or whether the facility will be needed in the future.

Table 8: Project sustainability

Project	Result
Sandvika-Asker	Good/uncertain. The project has not yet contributed to any modal shift. Benefits may be higher once all the sections of the railroad are completed. In a long term perspective, there is no doubt that the fast growing Oslo region will need significant capacity expansions of its public transport network.
Momarken-Sekkelsten	Good. Benefits are likely to continue in the future and despite traffic growth in excess of forecasts, the capacity of the road will be sufficient.
Riksgrensen-Svingenskogen	Good. Benefits are likely to continue in the future and despite traffic growth in excess of forecasts, the capacity of the road will be sufficient. The nearby customs station occasionally causes congestion. This may require alteration of the entry and exit from the road.
Eiksundsambandet	Good. The long term benefits from the road are likely to be more positive than the short term user benefits. It is expected that the significant reductions in travel times delivered by the project will contribute to more integrated labour markets and further increased productivity among businesses and public services.
Lofast	Good/uncertain. The present annual benefits delivered by the road are likely to continue. If, however, the alternative road discussed at the time of implementation (a tunnel to Vesterålen) should ever be realised – traffic levels will be significantly reduced and the road will only be of marginal benefit.

Sustainability is a demanding criterion to evaluate transport projects against. In most of the projects we have evaluated, there are no reasons to expect any significant reduction in traffic levels – present benefits are thus likely to continue. Most Norwegian roads outside major cities also have sufficient capacity to cater for future traffic growth. On the other hand, from a climate perspective road traffic at present levels could be considered unsustainable.

Economic profitability

Whilst the criteria above measure different objectives of projects, the economic appraisal seeks to calculate the overall economic profitability of a project based on summary measures such as the net present value or the benefit cost ratio. Social Cost-Benefit Analysis is by many considered as the gold standard of appraisal, but as we have argued there may be many reasons why a project is being selected and implemented. More than often it is to achieve a desired outcome, but of course – costs matter. The evaluations have thus included a conventional CBA as a value for money measure. The results of the ex post CBAs are shown in Table 9.

Table 9: Economic profitability

Project	Result
Sandvika-Asker	Most likely (very) negative. The evaluators were not capable of carrying out a CBA due to data limitations. However, given that changes in travel times and passenger levels have been negligible so far, it is unlikely that the project delivers a positive net present value.
Momarken-Sekkelsten	Very positive. Construction costs marginally above budget, but benefits have been higher than forecasted. Based on conservative assumptions, the project is now estimated to deliver a net present value of some 800 to 1400 million NOK.
Riksgrensen-Svingenskogen	Very positive. An ex post CBA estimates the net present value to be some 1.400 million NOK.
Eiksundsambandet	Very positive. An ex post CBA estimates the net present value to be some 1.700 NOK.
Lofast	Very negative. The original CBA showed a very negative net present value and despite more traffic than forecasted, the increase has been far from sufficient to alter the result.

It might seem straightforward to compare an ex post CBA to the original one after the project has been in operation for a few years. It is not. Since the original CBAs were conducted the appraisal framework rules have changed. Not only has assumptions regarding the discount rate, appraisal period, value of travel time etc. changed, but also the transport models and the software used in the appraisal. This means that an ex post CBA is not directly comparable to the original one, but it does demonstrate how society values the benefit of the project today. Carrying out a full CBA can be a time and resource consuming process which may come at the expense of the other evaluation criteria. A simplified CBA might thus be a more appropriate approach. In our case, three of the projects delivered higher benefits than originally estimated while the two others were either less beneficial or as negative to society in economic terms as the ex ante CBA demonstrated.

Table 10 summarises the results of the evaluations.

Table 10: Assessment of project success

	Sandvika-Asker	Momarken-Sekkelsten	Riksgrensen-Svingenskogen	Eiksund-sambandet	Lofast
Efficiency	Green	Yellow	Green	Green	Yellow
Effectiveness	Yellow	Green	Green	Green	Green
Impact	Yellow	Yellow	Green	Green	Yellow
Relevance	Green	Green	Green	Yellow	Yellow
Sustainability	Green	Green	Green	Green	Yellow
Socio economic profitability	Red	Green	Green	Green	Red

A majority of the projects that have been evaluated so far have been successful in their achievement of the stated objectives. The sample of projects is of course far too small to make any conclusions regarding the overall success of transport projects in Norway. In addition to other evaluation efforts it is, however, our hope that the evaluations carried out by the Concept Research Programme will provide insight into what constitutes projects success. In time, this could translate into better project selection.

5. Concluding remarks

Ex post evaluation is vital to determining whether the planned benefits of a project have been met or not. There is widespread agreement among both planners and decision makers of the need for ex post evaluations and yet, they remain rare in most countries. There is an increasing range of studies focusing on individual parameters included in the original CBA and some countries are also routinely carrying out full ex post CBAs. Comprehensive evaluation frameworks aiming to assess the projects' wider effects including their strategic performance are, however, not common.

In this paper we have demonstrated the use of an evaluation framework that has been widely used to evaluate development assistance projects. In our opinion, the goal oriented methodology presented herein is suitable for evaluating projects in a wider context than from just an economic point of view. Large public investment projects, and transport projects in particular, are often part of a wider strategy and may have objectives not necessarily covered by a traditional CBA. It is thus necessary to evaluate if the projects have been able to deliver according to the aspirations of the project owners.

We have demonstrated the use of the evaluation framework in five transport projects. The number of projects that have been evaluated so far is too few to make any conclusion regarding the overall success of Norwegian transport projects, but the purpose of the paper has rather been to assess if the methodology is suitable for ex post evaluation. One conclusion so far is that the six evaluation criteria complement each other and provide a suitable approach for evaluating large transport investment projects. The framework is flexible and works well in projects of different size, scope and also when data availability is an issue. Ex-post CBA provides, in our opinion, a more restricted perspective. Another major issue for CBA is the often lack of data making comprehensive ex post CBA a time and resource consuming process. And even

with data, CBA results will also be uncertain and the aggregate results presented might obscure rather than clarify whether project success have been achieved.

The evaluation framework has a clear strategic perspective. The criteria “impact”, “relevance” and “sustainability” is particularly useful for strategic assessment. It requires the evaluation to focus on wider effects such as economic development rather than traditional first-order effects.

The evaluations so far have all been carried out some 5-10 years after project opening. This is, in our opinion a suitable time frame for effects to materialise and stabilise. However, from a strategic perspective this may be too short.

The evaluation framework focuses on the project objectives, which normally are not presented in the CBAs. This is useful for assessing the performance of the projects ex post, for the design and implementation of the projects and moreover, it is useful for the overall accountability. A major challenge for evaluating goal achievement is, however, that the formally agreed objectives may be poorly formulated and unsuitable as a basis for evaluation.

Generally, unless there is an organised collection of data, quantitative methodologies for evaluation may be demanding, inadequate or impossible. Instead, we suggest a combined quantitative and qualitative approach including document analysis, site visits and, most importantly, interviews. Triangulation of information of different types, from different sources, different actors with differing priorities, etc. is one of the most powerful tools evaluators can use in their efforts to ensure that their conclusions are substantiated with information that is both relevant and true.

Ex post evaluations should ideally be facilitated already at the time of the investment decision. By ensuring that pre-project data is saved, and that the necessary data is collected in subsequent years, future evaluations will save a lot of effort. Another important lesson is that a minimum of standardisation of information will be useful in future evaluations. This will make it possible to draw lessons on specific topics across several projects of the same type, such as highway projects, railway projects, transport investment “packages”, etc. It is essential though that the evaluation framework is kept generic and flexible and that indicators under each evaluation criterion are selected in order to capture essential features of the investment project under study.

The six-criteria evaluation framework presented in this paper have so far been tested on five transport projects, as well as five projects from other parts of the public sector (one ICT project, one defence project and three building projects). The overall experience is that the methodology works well, but there is still room for improvement. The Concept Research Programme has ex post evaluations as one of its prime tasks and will provide additional evaluations annually. The program has more than 200 Norwegian investment projects in its database, and many of them are now entering their operational phase. The purpose of evaluation is clear – better practice, better project selection and accountability in the use of public resources. The evaluation framework presented herein could provide a useful methodology for other countries seeking to gauge the performance of public investments and to improve overall project governance.

References

- Barker, G., Beardsley, G. and Parsons, A., 2014. *The National Audit Office's value-for-money assessment of transport investments*. OECD/ITF Joint Transport Research Centre Discussion Paper No 2014-12. Paris.
- Bonnafous, A., 2014. *Permanent Observatories as Tools for Ex-Post Assessment: the French Case Study*. OECD/ITF Joint Transport Research Centre Discussion Paper No 2014-10. Paris.
- Börjesson, M., Eliasson, J. and Lundberg, M., 2014a. Is CBA Ranking of Transport Investments Robust? *Journal of Transport Economics and Policy*, 48 (2), pp. 189-204.
- Börjesson, M., Jonsson, D.R., Berglund, S. and Almström, P., 2014b. Land-use impacts in transport appraisal. *Research in Transportation Economics*, 47, pp. 82-91.
- Crossrail, 2010. *Crossrail business case. Summary report* [online]. Available from: <http://www.crossrail.co.uk/benefits/wider-economic-benefits/#> Accessed January 5, 2015.
- Eliasson, J., 2014. Introduction to the special issue on appraisal (editorial). *Research in Transport Economics*, 47, pp. 1-2.
- Eliasson, J., Börjesson, M., Odeck, J. and Welde, M., 2014. *Does benefit/cost-efficiency influence transport investment decisions?* Stockholm: Centre for Transport Studies. Working papers in Transport Economics 2014/6.
- Fridstrom L. and Elvik R., 1997. The barely revealed preference behind road investment priorities. *Public Choice*, 92 (1/2), pp. 145–168.
- Graham, D.J., 2009. Identifying urbanisation and localisation externalities in manufacturing and service industries. *Papers in Regional Science*, 88 (1), pp. 63–84.
- Highways Agency, 2013. *Post Opening Project Evaluation of Major Schemes. Meta-analysis 2013: Main Report* [online]. Available from: <http://assets.highways.gov.uk/our-road-network/pope/major-schemes/pope-meta-2013-final-report.pdf> Accessed: January 5, 2015.
- Heinzerling, L. og F. Ackerman (2002): *Pricing the priceless – Cost Benefit Analysis of Environmental Protection*. Georgetown Environmental Law and Policy Institute, Georgetown University Law Centre, Washington, USA
- Jansson, J.-O. and Nilsson, J.-E., 1989. Spelar samhällsøkonomiska kalkyler någon verklig roll i vägvesendet? *Ekonomisk Debatt*, 2, pp. 85–95.
- Knowles, R.D., 1981. Malapportionment on Norway's parliamentary elections since 1921. *Norsk Geografisk Tidsskrift*, 35 (3), 147-159.
- Laird, J.J. and Mackie, P.J., 2014. Wider economic benefits of transport schemes in remote rural areas. *Research in Transportation Economics*, 47, pp. 92-102.
- Mackie, P. and Preston, J., 1998. Twenty-one sources of error and bias in transport project appraisal. *Transport Policy*, 5, pp. 1-7.
- Mackie, P., Worsley, T. and Eliasson, 2014. Transport appraisal revisited. *Research in Transportation Economics*, 47, pp. 3-18.

- Nellthorp, J., and Mackie, P., 2000. The UK Roads Review—a hedonic model of decision making. *Transport Policy*, 7(2), pp. 127–138.
- Nicolaisen, M.S. and Driscoll, P.A., 2014. Ex-Post Evaluations of Demand Forecast Accuracy: A Literature Review. *Transport Reviews*, 34 (4), pp. 540-557.
- Nilsson, J.-E., 1991. Investment Decisions in a Public Bureaucracy: A Case Study of Swedish Road Planning Practices. *Journal of Transport Economics and Policy*, 25(2), pp. 163–175.
- Nyborg, K., 1998. Some Norwegian Politicians' Use of Cost-Benefit Analysis. *Public Choice*, 95, pp. 381–401.
- Næss, P., Nicolaisen, M.S. and Strand, A., 2012. Traffic Forecasts Ignoring Induced Demand: a Shaky Fundament for Cost-Benefit Analyses, *European Journal of Transport Infrastructure Research*, 12 (3), pp. 291-309
- OECD Development Assistance Committee, 1991. *Principles for Evaluation of Development Assistance*. OECD, Paris.
- Odeck, J., 1996. Ranking of regional road investment in Norway. *Transportation*, 23(2), pp. 123–140.
- Odeck, J., 2010. What Determines Decision-Makers' Preferences for Road Investments? Evidence from the Norwegian Road Sector. *Transport Reviews*, 30(4), pp. 473–494.
- Odeck, 2012. Lessons from ex-post benefit-cost analysis of road projects in Norway. Presented at *the 5th Concept Symposium on Project Governance*. Losby gods, September 20-21, 2012.
- Odeck, J., 2014. Do reforms reduce the magnitude of cost overruns in road projects? Statistical evidence from Norway. *Transportation Research Part A*, 65, pp. 68-79.
- Odeck, J., Volden, G.H. and Welde, M., 2015. The Impact of External Quality Assurance of Costs Estimates on Cost Overruns: Empirical Evidence from the Norwegian Road Sector. *European Journal of Transport and Infrastructure Research*, 15(3), pp. 1-7.
- Samset, K., 2003. *Project Evaluation. Making investments succeed*. Trondheim: Tapir Academic Press.
- Samset, K. and Volden, G.H., 2013. *Investing for Impact. Lessons with the Norwegian State Project Model and the first investment projects that have been subjected to external quality assurance*. Concept report no. 36. Trondheim: Norwegian University of Science and Technology.
- Standing Advisory Committee on Trunk Road Assessment (SACTRA), 1999. *Transport and the Economy*. Norwich: TSO.
- Venables, A.J., 2007. Evaluating urban transport improvements: cost-benefit analysis in the presence of agglomeration and income taxation. *Journal of Transport Economics and Policy*, 41 (2), pp. 173-188.
- Vickerman, R., 2008. Transit investments and economic development. *Research in Transport Economics*, 23 (1), pp. 107-115.
- Volden, G.H. and Samset, K., 2013. *Evaluating Public Investment Projects. Lessons and Advice from a Meta-Evaluation of Four Projects*. Concept report no. 30. Trondheim: Norwegian University of Science and Technology.

Welde, M. and Odeck, J., 2014. Cost increases in the front-end of Norwegian road projects. Paper presented at: *bEART 2014 - 3rd Symposium of the European Association for Research in Transportation*. University of Leeds UK, Institute for Transport Studies, September 10-12, 2014.

Williams, T. and Samset, K., 2010. Issues in Front-End Decision Making on Projects. *Project Management Journal*, 41 (2), pp. 38-49.

Worsley, T., 2014. *Ex-post Assessment of Transport Interventions and Policy Interventions. Roundtable Summary and Conclusions*. OECD ITF Discussion paper 2014 /19.