EX POST ANALYSES AND TOOLS: WHAT SHOULD YOU EXPECT?

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1. INTRODUCTION

Although transport investments projects are quite costly and, in turn, are expected to generate economic benefits, there is a general lack of ex-post observation of their actual impacts.

The aim of this paper is to present some methods of analyses and tools that have been developed in order to generate ex-post knowledge from implemented projects and to illustrate these findings with actual examples in several parts of the world. We will focus on knowledge improvement issues, setting aside the transparency and governance issues inherent to any kind of ex-post endeavour, notwithstanding their importance for the general public.

More precisely, we present three approaches to structuring analyses and tools, presenting and discussing them together with their intended use. The three general types presented in the following sections are: ex-post study at a project level; ex-post analyses at an aggregate level (collection of projects); a data base of ex-post observations on a set of projects designed for helping ex-ante project assessment.

In the final section we discuss how ex-post analyses may contribute to improving the accuracy and overall quality of ex ante analysis and project selection when designed with a global « life-cycle like » view.

2. EX POST AT PROJECT LEVEL: A CASE FROM THE NETHERLANDS

2.1 Status and initiatives for ex-post evaluation of infrastructure in the Netherlands

Infrastructure projects in the Netherlands are evaluated with the use of Cost Benefit Analysis (CBA), prior to the decision to go ahead with the project or not. Detailed guidelines exist for the ex-ante evaluation of projects (CPB & PBL, 2013, Rijkswaterstaat, 2012) with instructions on how to perform a cost benefit analysis in order to arrive at standardized assessment of impacts of these type of projects. However, there are no guidelines for ex-post analysis of project impacts.

In general, ex-post assessments are considered useful, either to determine whether funds have been well spent (accountability), or to improve on ex-ante evaluation methodologies. It is customary to make an evaluation of the project management process and to reassess costs and traffic forecasts. An ex-post

analysis using CBA is however a voluntary task, not an obligation. As a consequence, it is not customary to revisit all the CBA calculations to see if they were on target.

To further the use of ex-post analysis based on CBA, KiM Netherlands Institute of Transport Policy Analysis embarked on a series of reports and activities, partially in cooperation with other research institutes. It started off with an analysis of ex post evaluation practices in other countries and with a literature analysis (KiM, 2009).

In the next step KiM performed an ex post CBA of a new stretch of the A5 highway, a 7-kilometre stretch of new Dutch motorway, in cooperation with PBL, the Netherlands Environmental Assessment Agency. The objective of the case study was to demonstrate what can be learned, just from one individual case study. The aim of the case study was to improve ex-ante evaluation methodology with the help of CBA, and to determine the optimal functionality of ex-post evaluations.

The most recent action was a round of interviews within the Ministry of Transport and Environment to determine the possibilities for a more structural use of cost benefit analysis for ex post evaluation. In order to promote these possibilities, we developed a fold-out map with the essentials of ex post evaluation based on CBA with do s and don ts.

2.2   Case study A5: lessons learned

The case study (PBL& KiM, 2010) looked at the development of highway A5 in the vicinity of Schiphol airport. This relatively small trajectory of 7 kilometres provided an additional link between highway A4 and A9. It provided relief for the congested existing connection between A4 and A9 and, also reduced distance travelled for some of the traffic in this corridor. The highway was opened in 2003 after a lengthy decision making process. In 1985 the first studies inventoried the future need for infrastructure. The project document on which the decision to start building was based dates from 1989.
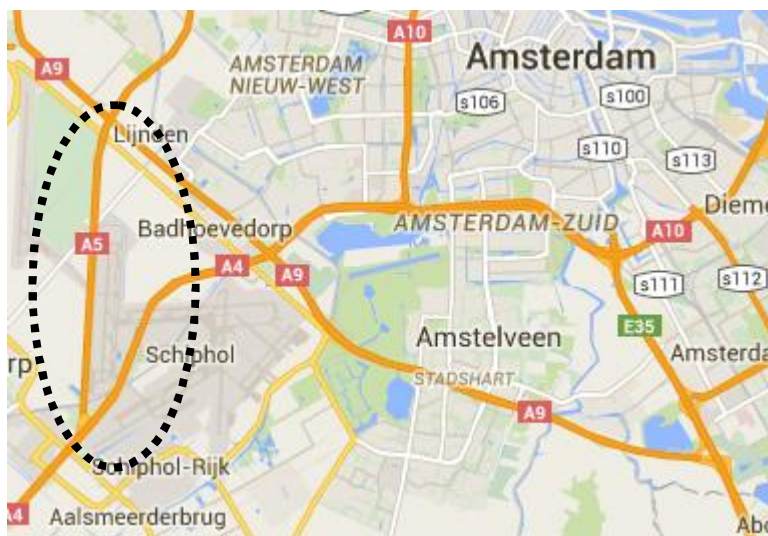
Fig.1 Situation map of the new highway connection A5 Verlengde Westrandweg

In the case study, an estimation or measurement was made of the before and after situation for a number of welfare impacts: total project costs, mobility impacts (travel time savings), safety and environmental impacts. The case study made clear that ex-post evaluation in actual practice is not an easy task. The main findings of the study are:

- Impacts, estimations beforehand versus realization:
  o Mobility: increase on traffic on A5, decrease on highways A4 and A9. Estimated reduction of congestion was not able to be compared due to the inability to replicate measurements and indicators for congestion reduction used in the original study.
  o Nature, environment and safety: environmental impacts were estimated conservatively due to underestimation of technological developments. The emissions were lower than expected beforehand. The safety increased in the studied area of the network. It is unclear however if this is due to the impact of the A5 or of other factors external to the project.
  o Costs were lower than expected beforehand, but the project was also somewhat downscaled.

- Conclusions on the focus, timing and scope of the CBA analysis:
  o The long time between the project report and decision (14 years) hampers the comparison of impacts as the time horizon of the calculations ended before the year of decision making.
  o The case study showed growth effects until the 5th year after opening, possibly linked to delays in behavior changes. It is best to make measurements after 5 years instead of after for instance one year.
  o The policy indicators and data collected should be adaptable for future use. In this case study, the policy objectives and the way they are measured changed. Meaning that the forecast units of 1989 were not translatable in the measurement units of 2008.
  o The scope of the project was bigger in 1989, than what was actually realized. Only a segment of the total project of 1989 was developed and on the level of the actually realized part of the project, no data were available.
  o The level of detail of available data dictates the level of detail that is possible in the ex post evaluation. It doesn't work the other way around
- Lessons for future CBA's, environmental impact assessment and forecast models:
  o Anticipate questions about the effectiveness of project components and phases.
  o Ex-post evaluations can also be used for learning between different projects, for instance on accuracy of cost calculations.
  o Provide insight in the uncertain future by using multiple scenarios. This should be standard procedure.

        o   Use backcasting for recalibration or validating a model

The case study showed us which conditions should be met ex-ante, in order to be able to perform a comparison afterward for all aspects of the CBA. If the ex-ante CBA is not according to guidelines or lacks a certain amount of information (for instance on the applied transport forecast model), it is impossible to make a good ex-post analysis. Therefore, post-opening evaluation starts with investigating the pre-opening studies. Any post-opening assessment is destined to fail if the data required to conduct such a post-opening evaluation cannot be retrieved. In our case study, none of the traffic models or indicators that had been used in the ex-ante studies to measure congestion were in use anymore, nor was a definition of the indicators available. Such situations considerably hamper ex-post evaluations. Furthermore, a new road is often part of a more extensive programme with accompanying policies. When an ex-ante evaluation comprises such an extensive programme as a whole, it is extremely difficult to evaluate, ex post, the impact of an isolated component of the programme.

Ex-post analysis is only possible on the exact same level of detail as the estimations in the ex-ante analysis. If the evaluation was on the level of a programme consisting of multiple projects, the ex post evaluation should contain all these sub projects. It is therefore necessary to have estimations on effectiveness and efficiency on the level of these subprojects. In case parts of the programme end up not being realized, the information will be there to compare the before and after calculation of the individual subprojects.

The case study also showed that the timing of the studies deserves attention. As the decision-making process for new infrastructure in the Netherlands until a few years ago used to be rather slow, the time horizon of ex-ante studies is often already passed when a new road is opened. In such cases, a short reconsideration of the main findings in ex-ante studies just before tendering for construction contracts could be useful. Furthermore, monitoring of traffic intensities in a wider region just before and just after a new road has been opened also provides useful indications of the impact of the new road and thus of the accuracy of the traffic models used.

2.3 Insights for ex-post generalization in the Netherlands

- Ex-post analysis is not typically done. However, it can be used to assess various methods of analysis (for instance CBA, Multi criteria assessment, effectiveness measurements), subjects (process, costs, traffic forecasts, various types of benefits) and scope (policy objectives, programmes, projects); and it can be done with differing levels of detail. It is therefore necessary to clearly communicate what type of ex post evaluation is envisaged. Ex post evaluations based on CBA are rare in the Netherlands. Once the infrastructure project is finished, there is low motivation for knowing if the project was a good choice or not, if expectations are met and if not, what the reasons for these deviations are. Other types of ex-post evaluations are more common, for instance on the process management of a project or on projected costs or on the traffic forecast.

- If more ex post evaluations based on CBA were considered necessary, it should be made clear what exactly should be done. It would be necessary to make some guidelines on:
  - Which type of projects;
  - When (after 1 year or later?);
  - Which level of detail;
  - Which focus (programme or project);
  - All costs and benefits or just the major ones?

A large scope of projects covered by ex-post studies could increase the motivation for performing these studies, since it would greatly increase the interest of a feedback identifying ways to improve the quality of ex-ante assessments, as the next section will show.

3.   EX POST AT AGGREGATE LEVEL: AN EXAMPLE IN FRANCE

In France, ex-post evaluation of big transport infrastructure projects was made compulsory in 1982 (LOTI law). This obligation applies to all projects over 83 million euros. Under LOTI, an ex-post study is to be made about 5 years after the infrastructure begins operations or, when several adjacent sections are built successively, after the last one is built.

The objectives of these ex-post studies are the following (after CGPC, 2003):

- Compare actual outcomes to those initially anticipated and explain the differences,
- Observe projects effects and when some are negative give suggestions for reducing them,
- Verify that the owner complied with their obligations and promises,
- Inform the public of the outcome of the ex post analysis, and
- Give a feedback for future ex-ante evaluations, especially regarding coping with risks and uncertainties.

The reader will note that the last objective goes beyond project level. There is now a collection of such studies, which gives a good example of what ex-post analyses at an aggregate level may offer.

In France, such aggregate studies are facilitated since standard ex-ante and ex-post evaluation methods are set nationally. This provides a common background and some keys for explaining some observations.

3.1   From project level to aggregate level

We will now review the objectives mentioned above and illustrate for each of them the kind of issues that aggregate analyses may shed light on.

The first objective consists in confronting actual outcomes to those initially anticipated. Thus, the focus is put on identification of the difference between forecast and actual outcome. At the project level, this information is specific, but at an aggregate level, we may observe the distribution of differences, and

try to detect regularities in these differences, or perhaps even look for biases when the mean of differences is significantly different from 0. Is there a small or big spread of the differences, as measured by simple indicators such as standard deviation, or by more sophisticated ones? These are the type of questions which transversal studies covering a collection of ex-post studies may address (on the French LOTI studies, see for instance Taroux et al 2005, SETRA 2008 or Meunier 2010, 2012).

When differences between forecast variables and their actual values are observed, we need to explain the differences: at project level, many specific elements may have interfered. Some relate to highly unexpected events affecting the project, sometimes even unforeseeable shocks; some are highly project-specific but, often, the plausibility and robustness of forecasting assumptions and methods are questioned.

At an aggregate level, it is then possible to look for frequent causes of differences, or at least to detect the main components that produce these differences (key steps of traffic modelling or CBA, types of impacts or values especially sensitive or influent, assumptions taken for evolution rates, etc). Thus ex-post studies at an aggregate level may generate important information for improving the quality of ex-ante studies, at least if the time span between production of ex-ante forecast and its ex-post evaluation, which typically about 15 years, is not so big that methods and practices have greatly evolved in the meantime.

When this is the case, the ex-post exercise is more difficult to make: analysing a study with new tools very likely does not give a comparable view of the quality of the work done initially. This is why CGPC (2003) recommended that ex-post studies be made using methods and values as close as possible to those used in the forecasts. In practice, this is not so easy since, for instance, old software versions may not be available anymore, or the ex-ante datasets have been lost. This is why aggregate ex-post studies need continuity and an organised memory of the studies and of their tools. Finally, this first set of objectives for ex-post analysis at project level may be very interesting for analysing quality of the assessment system and the ways to improve it.

Second type of objectives: the observation of the project$ effects. This is a much broader objective since it may cover any kind of impact, not necessarily economic ones; even environmental or social impacts may be useful for informing CBA. For instance, environmental impacts, although specific at the project level, may generate concerns for subsequent, related projects. This is because stakeholders may associate the impacts experienced in one project with proposed projects of a similar type or in the same general location,. Thus detection of impacts and their potential for occurring in other locations or for other, similar projects may provide information about both real and perceived future projectsq risks regarding acceptability, costs (for instance through additional protective measures) or delays. Such elements may give way to an adjustment of some assumptions taken for CBA (e.g. price level announced by project owner) or to an introduction of sensitivity tests. More commonly, ex-

post observation of economic effects and variables may inform future CBA studies and future projects; Section 4 will develop some of these issues.

Also, when some impacts are negative, measures aiming at reducing them may be proposed in the ex-post study, or imagined by the project owner in reaction to this study. Some of them may be transferable to other projects, which then relies on the project owner's own cumulated experience, knowledge sharing within professional networks, or sometimes more organised feedback systems, at a regional or national level. In France, we don't have yet such a nationally organised feedback system although some elements exist, and the CGEDD's official report on each LOTI ex-post study often contains comments on measures that could be taken also elsewhere.

Third objective: check that the owner complied with their obligations and promises. This item is very project specific, but comments in the CGEDD reports are made concerning general lessons regarding efficient implementation and publicity of obligations, the technical relevance of promises, or the degree of difficulty of fulfilling them. Informing the public is another objective that can go beyond the project's level. In France ex-post reports are supposed to be made public, thus providing material for broader analyses, addressing ex-ante assessment specialists, project owners, stakeholders, NGOs and the general public. It may even sometimes be of interest to other countries and several international studies exist (Flyvbjerg 2003, Meunier and Welde 2016). In practice, CGEDD reports are all available on Internet, as are most ex-post studies in France.

The final objective listed above goes beyond project level: giving feedback for future ex-ante evaluations, especially regarding coping with risks and uncertainties. We have seen such uses above, and it is important that this objective be officially supported nationally. As already said, there is no national official feedback process, but besides the initiatives of specialists or project owners, there exist some national technical advisories such as SETRA (2008). Broader views may be found in a special annex of the Quinet (2013) report, and more recently a national committee of users was created as part of the new national evaluation framework, along with a scientific committee.

Also, besides the horizontal ex-post aggregation and sharing of experience, longitudinal analyses have been set by creating long term observatories in some areas or for some very big projects (see Bonnafous (2014)). The latest example is the observatory set up for the high-speed line Sud Europe Atlantique, which is being organised and prepared before the project is completed, so as to measure the pre-project situation in order to better capture the project's effects.

3.2   Examples of feedback results

Feedback often consists of very basic recommendations, dealing with basic quality reflexes that should normally be put in practice. For instance, observations of differences between forecast and actual outcomes regarding improvement of the level of service (e.g. individual travel time gains), safety

effects, environmental concerns, CO2, etc., confirm the importance of using up-to-date parameter values and consistent evolution assumptions in the ex-ante studies. An example is the safety ratio used for road projects in France, which in some ex-ante studies is based on ratios observed several years before the study, whereas we have experienced sharp reduction in fatality rates for instance. Thus, one of the first recommendations is to regularly update the assumptions on the evolution of the relative prices (ex: petrol) or unit values (ex: pollution externalities) used for key parameters (value of time, CO2, õ) but also of the performance ratios (average emissions of vehicles, safety performance, õ), consistently with observed trends and public policies which will influence these ratios.

Feedback recommendations from aggregate studies insist on making correct risk analyses at the ex-ante stage since they have a key role for understanding and taking account of risks in CBA. They question the sometimes blunt use of geometric evolution rates for medium and long term analyses, especially now that low or very low discount rates are applied, which gives greater importance to properly assessing mid and long term evolutions.

Feedback on the general evolution of ex-ante studiesq quality is mixed: although methods and tools have improved, it does not seem that the accuracy of traffic, cost or economic indicators of project value have improved with time. This is perhaps due to the increased complexity of projects and network interactions, among other factors.

The interest of aggregate studies as regards information on risks and uncertainties begins with the mere observation of the distribution of assessment %errors+, and the observation of actual expression of risky events for some projects. But it is also progressively possible to extract deeper feedbacks for operational treatment of risk issues in the ex-ante evaluation.

For instance, when compiling a series of ex-post project evaluations, it is possible to simply estimate the mean of the differences between actual and forecast indicators for cost, traffic. A few countries like UK use this kind of information for deriving systematic corrections to cost estimates, hoping to set back the mean to 0. But also estimates of standard deviation and other information on the distribution of these differences, and on correlations between differences, could be used to inform ex-ante assessment on how to specify Monte-Carlo simulations (e.g., which distributions and parameters could be used) or, more simply, for designing accurate sensitivity tests. Some transversal studies are progressively made (Meunier 2012) but they need firstly consolidated samples to give relevant information.

3.3   Development of an aggregate level ex-post system

This brings us to the question of building an aggregate level ex-post system. First, besides the uses that will be developed in Section 4, such a system would be useful for informing the evolution of ex-ante methods and for

expanding on a much broader basis the individual experience of CBA practitioners and other interested groups.

It would need an organised feedback from aggregate ex-post analyses, at least at a national level, open at least to ex-ante specialists and project owners. The increasing importance of consultations and public debates, and the issue of "participative democracy", raise the question of an opening to stakeholders and the public.

We have just introduced briefly some of the issues at stake when considering building an aggregate feedback system, the next section will discuss a concrete example.

4.   EX POST DATA BASE IN THE USA

The focus of public infrastructure investment in the US has historically been linked to economic development. From the earliest days of the republic, federal and state governments have focused on providing funding for ports, roadways, and waterways. The Erie Canal in New York State was one of the first major transportation projects of the 18th century. Records from that period of time documented a twenty-fold decrease in the price of wheat in Eastern urban markets and major migration to, and industrial development in, what were then the Western Territories of the US (New York State Archives, 2014). As railroads emerged in the mid-19th century, the federal government made rail system expansion in the western US a priority though a unique land-grant program that enabled an emerging transportation mode to fund expansion using federal land grants to underwrite the westward expansion of the rail system by encouraging agricultural development and linking newly established cities and towns (U.S. Congress, 1862). In the mid-20th century, a similar initiative by the federal government was undertaken to expand the existing US highway network into a truly national system (Federal-Aid Highway Act of 1956). The history and influence of the interstate system on post-war economic development were put into perspective on the 50th anniversary of signing of the Highway Act (FHWA 2016.)

The economy of US today, and indeed most of the developed world, is supported by a very dense network of transportation infrastructure built on the technologies of the 19th and 20th centuries. Continued investment in the last half of the 20th century was justified on the basis of past associations with the kinds of economic development that was historically . whether through anecdote or empirical support . assumed to accompany these investments. However, the relationship between such transportation investments and economic development has been brought into question by a several recent studies.   First, the strong historical linkages between transportation investment and economic development have been questioned in economies with high network densities. This emerging trend was identified in the late 20th century (Nadiri & Mamuneas, 1998) and has continued to be noted in recent research (Iacono & Levinson, 2016). Second, as more emphasis has

been placed on performance measurement, especially for federal programs and investments in the US[1] and as guidance for addressing these requirements have been developed (GAO, 1996 and GAO 2012), all federal agencies and sponsored programs have begun to assess the ways in which funding for their programs and investment strategies have performed relative to delivery of results. Both transportation agencies and agencies focused on economic development have devoted considerable effort to documenting the relationship between the level and types of infrastructure investment and measures of economic development (FHWA 1995, FHWA 2005, and Appalachian Regional Commission (ARC) (2000, 2007, 2008 and 2013).

These studies pointed to the likelihood that there are multiple interactions affecting economic development that require careful evaluation before any conclusions can be offered. Separation of effects of land use decisions, transportation infrastructure investments, non-transportation improvements (e.g., sewer and water access), and work force training and readiness, among the more readily apparent factors, all affect economic development. Moreover, interactions assessed in these cases indicated that the time needed to achieve long-term economic development expectations could vary greatly depending on the combination of investments, initiatives undertaken to support these investments, and factors outside of the control of governmental agencies making these investments . primarily national economic cycles and regional disparities in underlying economic growth.

4.1 The SHRP2 Capacity Program Ex Post Research Project

With all of this as background, the U.S. Congress in 2005 authorized the Second Strategic Highway Research Program (SHRP2). A systematic approach to ex post based analysis was initiated that resulted in a project, entitled %Interactions Between Transportation Capacity, Economic Systems and Land Use Merged with Integrating Economic Conditions in Project Development+ (SHRP2, 2007). This project was dedicated to creating a database of case studies designed to answer many of the lingering questions about the interactions between transportation investment and other factors influencing economic development.

Both qualitative and quantitative measures of the effects of transportation investments were developed for 100 case studies (SHRP2, 2012). The ex post analysis methods depended heavily on a series of coordinated interviews with local, state and federal officials involved in each project, as well as private developers and property owners. The development of the cases studied for this research project were unique in several ways:

- **A carefully specified set of guidelines was developed for interviewing and preparing information for each case**. Researchers were trained in interview methods and data collection prior to undertaking case development; lessons learned in the training of case study developers and experience gained during the case study development process were incorporated into a Users Guide and a

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[1] Government Performance and Results Act of 1993 (GRPA)

Handbook for Practitioners; and an on-line instructional course was developed and is currently in use in pilot studies involving several state Departments of Transportation (DOTs) as they develop cases to be added to the current database.

- **A searchable database was developed.** Project types, conditions and development related circumstances similar to projects proposed by DOTs and Metropolitan Planning Organizations (MPOs) can be quickly scanned to assess a range of factors contributing to the success of new projects while they are in the early stages of planning.

- **Information developed through ex post analysis of the case studies was assessed and an on-line tool designed.** This system provides estimates of initial ranges of the types of employment, wages and output likely to result from investment in projects types covered in the database. Results obtained from the tool are sensitive to such factors as system performance, local land use policies, the level of other non-transportation infrastructure investments, and business climate.

All of the information, data and guidelines developed for this research program are available on the Internet at: www.tpics.us and documented in the series of research reports generated by this study (SHRP2, 2012). Results of this research have since been incorporated into an implementation program sponsored by the US Federal Highway Administration (FHWA) and managed by the American Association of State Highway and Transportation Officials (AASHTO). The database and associated technical support documentation has been rebranded as EconWorks (see: https://planningtools.transportation.org/13/econworks.html) .

4.2 Information Available from the EconWorks Database

The EconWorks database includes a broad range of data and descriptive information for each case. Data is divided into six categories, each with specific requirements in terms of the definition of the data collected and methods by which the data are collected:

- **Characteristics and setting** . Project type, location, costs of construction, dates of construction and post-construction study date (year in which impacts were assessed);
- **Pre/Post Economic conditions** . Data for the period before construction began and for the study date reflecting income, employment/unemployment, business sales, tax revenues, population, property values and population density;
- **Project Economic Impacts** . Direct, indirect and total economic impacts measured by employment, income and output (direct employment and income determined through interviews undertaken for each case study);
- **Case Location** . Aerial views of the location for each case referenced to Google maps based on the geographic limits of each projects;

- **Narrative** . a description of the project including a short synopsis of the purpose of the project, background, motivation, and a description of direct project impacts;
- **Non-transportation factors** . Initiatives, investments and other actions that had some effect on the way in which the project developed over time; and
- **Resources Consulted** . Listing of all reference materials use in developing the case, citations to reports and materials.

All quantifiable information, including characteristics of the case, motivation, and other descriptive data are also downloadable in spreadsheet form. This information as well as the meta-analysis of the case study database has been compiled as part of the on-line documentation for EconWorks, and has been described in several studies and papers related to the EconWorks project (Weisbrod, 2015; Fitzroy et al, 2014).

4.3   Findings from Original SHRP2 Cases

Each case study had its own unique characteristics and consequently very specific economic impacts based on the setting, local economic conditions and other non-transportation factors associated with its development. However, by analysing information for the entire data set of cases, some important insights into the consequences of transportation investments and location, setting and local economic conditions were developed. These included the following:

- **Job impacts have a wide variation when considering project location and type**. Most projects produced some direct economic effects, although several projects had no effect.
- **No individual economic impact measure can capture the range of the economic growth and development effects of all types of projects**. Various types of projects lead to economic impacts at different spatial scales, which unfold differently over time.
- **Economic conditions in which the project is developed is an important factor**. Projects tend to generate greater employment and a wider range of positive economic effects in locations that are not otherwise economically disadvantaged.
- **Project location is an important factor in supporting achievement of economic goals associated with transportation project development**. Projects in urban areas are generally more closely connected with and benefit more from improved market access than rural areas.   Rural projects focus on attracting activity into their economic region so employment improvements tend to be scaled to the overall size of the individual rural area.
- **Varied motivations for projects influence the non-transportation investments supporting project development and can influence outcomes**. Urban projects focused on improving market access and connectivity usually result in economic impacts that are magnified by these factors. Projects constructed to address environmental, safety,

congestion relief, or transportation infrastructure preservation typically produce lower economic impacts.

- **Projects that are coordinated with broader planning and investments tend to produce measurably greater economic impacts**. Interagency coordination, a common vision and other complementary non-transportation investments tend to lead to better economic outcomes.

4.4   Implementation of Ex Post Analysis Methods

Since the release of the SHRP2 case study database, the FHWA in conjunction with AASHTO has embarked on a program to implement this ex post analysis data system. The EconWorks, the implementation program has several key objectives:

- Expand the ex post analysis system to include transit projects (TCRP, 2016);
- Implement a program involving state DOTs and MPOs to develop additional cases for the EconWorks data base;
- Expand sponsored research to include funding for a new center for ex post research to lead development and refinement of ex post analysis, train academics and practitioners on the development of case studies supporting ex post analysis, develop new and improved methods of ex post analysis, and oversee the training of case study developers and additional cases; and
- Revise the underlying meta-analysis to include new cases and refine the tools developed for estimating potential economic development.

4.5   Conclusion Ë The US Experience

Ex post analysis and the case-based approach to assessing transportation infrastructure investments have a long history in the US. But, it has rarely been systematically used or developed in a way that provides some level of rigor or consistency for a large number of projects. Through the SHRP2 research program, and other more limited initiatives involving transportation and other governmental agencies, multiple case-based methods of analysis emerged over the past decade and have been refined to support robust ex post analysis. This SHRP2 research program provided a foundation for showing how ex post analysis could be used in combination with multi-case analysis to bring greater insights into the performance of transportation infrastructure investment. Filling in the gaps in the SHRP2 research, involving DOTs and other transportation agencies in developing cases to fill these gaps, and fostering the research, training and development of new cases is expected to improve and expand the insights gained from ex post analysis in the US.

5.   IMPROVING EX ANTE ANALYSES, PROJECT DESIGN & SELECTION

After presenting the three examples and types of ex-post analyses, we will now discuss the relations between project design, ex-ante assessment and

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project selection, and ex-post analyses, interpreted as part of a consistent system.

The main aim of an ex-post CBA evaluation can be twofold: to learn for future projects and their assessment or to justify the expenses on the project and confirm the public commitments concerning the project. First, communicating on the intention to make an ex post evaluation beforehand may already have influence on the quality of ex ante evaluations. Predictions might be made with more care if it is certain that they will be confronted with actual figures later on.

An ex-post evaluation doesn't start after the project but already in the phase of ex ante evaluation by taking measures needed to collect the necessary information on pre-construction conditions, and making some person or organization responsible for data collection and ex post evaluation, securing also the budget and means necessary to fund the whole ex-post process.
Thus, ex-post and ex-ante have to be interpreted in a cycle-like framework. This is true at project level, and even more at a more aggregate level where feedback from past projects may help improve present and future projects. Without ex-post gathering and sharing, may it be through a nationally centralized process or through more informal ways (for instance self-organisation of professional networks), a project owner or project designer, or the person in charge of ex-ante evaluation, all rely first on their personal experience and knowledge. The problem with transport projects is that they have a long lifetime, and thus the experience gained by one person is very limited in a world where the variety and complexity of transport projects is continuously increasing.

A first answer to this problem is internal sharing within each of the consulting companies that do design studies or ex-ante evaluations. But this privatized knowledge is not satisfying and their basis of experience stays quite limited, especially for big projects since those are rare while in the same time we would need to observe many of them to derive reliable knowledge. The problem is that organizing knowledge gathering and sharing needs motivated people, some material means and goodwill of contributing parties. At the scale of consulting companies, the driver is that the added value generated is commercially valuable. At bigger scales, these conditions are difficult to meet, even for big professional networking organizations.

Therefore, we need some common driving force that would initiate the ex post analysis process and maintain it on the long term, ensuring availability of data and the capacity for analyzing it and for communicating on the results. Section 4 showed such an example, with initial research investment at first, then with a combination of national commitment and organization of actors and sponsors, hoping for a snowball effect to maintain the process. When its value for professional and academics is recognized, both feel compelled to feed the system and keep the minimal investment needed for it to continue to give reliable and up to date information. Section 3 showed another example, where the basic driving force consists in an obligation by the law to produce ex-post studies, and also to make them public.

Still, the loop is not complete in these examples since formally no official feedback system is connected to new projects and ex-ante assessment. This closing connection is ensured in practice more informally by means of committees involving all the types of stakeholders.

When such a feedback system exists and has sufficient audience, and is scientifically backed or at least has the reputation of being reliable, it becomes much easier for a project owner to favor or impose its use on the contractors in charge of the projects design or assessment. When integrated in professional practices, it becomes natural for these contractors to use it and to feed it with fresh data. It is really a complete cycle that can emerge, where everyone finds its interest in building a common knowledge, maintaining and improving it.

6.   CONCLUSION

We have presented three types of ex-post approaches which, in a nutshell, respectively produce: technical and public reporting on a public project; feedback on the quality of ex-ante assessment methods and practice, hints for its improvement and for project design; collective building and sharing on diversified economic impacts of transport projects

We illustrated the kind of knowledge and insights they can provide and showed that besides straightforward comparison of project outcomes to their initial objectives and expectations, these approaches can also be used to:

- Inform the accuracy of ex-ante assessment methods

- Indicate how project design and development can be better informed and could take account of risks and uncertainties (gradual evolutions, shocks)

- Provide valuable feedback for ex-ante project assessment (and communication) when comparing proposed investments to past project types, characteristics, direct impacts and wider economic impacts.

- Assess the projects' worth in economic terms.

Thus, the variety of outputs that ex-post approaches can deliver makes them useful for decision makers, project designers, ex-ante study, and more specifically both practitioners and academics. Clearly, there is more than one standard for ex-post evaluation, not only regarding methodological choices, but also at the level of their design and uses.

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