

## Risks in a Public Project: The Millau Viaduct

The project of constructing a huge bridge for the central North–South freeway axis in France, opened many fundamental problems in public decision processes and risk management. We focus on this example to illustrate risk-taking problems because of its width, its strategic importance for managing a region and because of its socio-economical as well as ecological impacts. The project was introduced by several individual propositions: they were then shared between groups of decision-makers, discussed among meeting participants, violently defended on some occasions or abandoned for new ones when they were more easily agreed on. In the end, the choice had to be collective in some sense we shall investigate, even though there is only one person (the Minister of Transportation in this case) responsible to sign up the final decision.

The choice process is complex, more or less organised according to state regulations, and its characteristics vary depending on the level at which partial decisions are taken. We shall mention some of the process features that we need to understand, but the process itself is outside the scope of economics and of this book. A main trait we are particularly interested in for this part of the book, is the distinction between individual and collective choice at different stages of the process.

The choice is individual if a unique person or a group speaking in one voice makes a decision, it is collective when an assembly uses some process to choose among alternative decisions. In both cases, the main arguments for a project's pros and cons rely on previous studies of its possible impacts. There are many of them, at all stages of the construction and even during the decision process itself. Some impacts concern individual agents,<sup>1</sup> others are collectively perceived. The way impacts are perceived results from reactions to previous, similar ones. Indeed, individual behaviours about the construction project may modify its consequences. For instance, the announcement of the project has induced some speculation about the concerned lands, hence increasing costs. During the construction works, thousands of visitors invaded the plant so that Millau township had to organise them in a way not to perturb works. Furthermore, overseers had to be employed to prevent some visitors taking and causing risks, because of their hazardous behaviours. On the other hand, constructions induced many lateral activities in the area, generating incomes and attracting workers.

Public investment decisions follow a regulated procedure, which is codified in France<sup>2</sup> and in many countries; it may be based on jurisprudence in other countries. In all cases, except

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<sup>1</sup> By agents, we mean economic agents, i.e. individuals as well as firms or official organisations.

<sup>2</sup> Concerning transport, a law article makes precise the internal transportation regulations (LOTI, 30 décembre 1982). Furthermore, the state-owned consulting group edited a Recommendation Guide on Economic and Social Valuation for inter-cities road projects: “Évaluation et économique et sociale des projets routiers interurbains”, SETRA.

maybe in a dictatorship, we can find some common elements in the preparatory studies. The main ones concern a study of impacts and a cost–benefit analysis: they serve as a basis for the political decision, which is taken in the last rounds of the choice process. In France, the political system is founded on the people’s representation by assemblies, which sit at different levels: town, county, regional councils and finally the national assembly. In the case of the viaduct project, all of these councils have been consulted and they presented alternative issues or chose among the proposed ones. In the last round, however, the minister in charge of public transportation ended the process. This last decision was driven by technocratic civil servants, who were in charge of studies and reports of the different assemblies’ decisions. Studies were done by consulting groups in engineering, by experts in geology and by some economists,<sup>3</sup> at a rather theoretical level for the latter. Indeed, implementing practical impact valuations according to the theories and tools presented in this book would have required a number of workers and a lot of time, well beyond the willingness to pay of the Ministry. In fact, the idea of this book and some of its materials came partly from our amazement at the ignorance of engineers and technocratic civil servants about the existence of managing tools and theoretical means of study, for risky investments.

A study consists of producing a complete list of possible impacts, having several alternative solutions to propose and finally following a comprehensible comparison process between impact valuations and solutions, in order to guide decisions that will be made at a political level. Impact valuation and analysis present many difficulties. Identifying concerned populations and environments can take a long time and one must be prompt to add to the list during the study. Valuation methods based on inquiries require the elaboration of consistent and credible scenarios to be presented to the population sample. Uncertainty opens up a whole new problem in itself. First of all, it is generally controversial. Even at a technical level, architects do not agree. Engineers with the same background disagree about some risks and their management during the construction process. At the population level, unreliable information, ethical values and cultural prejudice interfere with an objective description of uncertainty and its valuation. Furthermore, too much focus on hazards, damages and inconveniences among the population, as well as by people who could be held responsible, biases judgement on the balance that must be found between possible benefits and losses. Last but not least, uncertainty quantification, i.e. assigning probability measures or at least a ranking among likelihoods, is highly controversial in general. Add to this that any retained possible event requires a new scenario in the inquiries and a partition of the population sample, given that each subsample can be presented with only one credible situation.

The study of alternative solutions is more technical, but raises other types of uncertainty and controversy on technological choices and on risk valuation and control. These uncertainties regard technical means as well as financial managing instruments. Whatever the approach chosen for the study, a method must be elected to compare solutions. Two extreme cases can be considered: the first one would try and take all the complexities into account, while the second option relies on the analysis of solutions only.

In a centralised procedure such as the one here, the first case is not convenient because complexity makes choices rather obscure and prevents a clear justification of opposable solutions. The second one is flawed by its arbitrary simplifications and reductions, which induce us to neglect some relevant elements that were present in the studies.

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<sup>3</sup> Among them, the authors of this book who presented some of the material contained in this book.

Economic analysis is considered as belonging to the second category. Cost–benefit analysis is typically presented in a particularly simplified and reducing manner. For instance, it would be very reducing indeed to consider net benefit as a decision criterion: it is only an indication, summarising the economic and financial analysis in order to guide political decisions. Economists, as well as the other experts called in the study, should be careful to present the assumptions and their limitations together with the results they obtained. Then, decision-makers should take these limitations into account to ponder the results and make their choices in accordance with the importance they attach to them.

The viaduct in question relies on two high plains in the mountainous relief of central South France. This region has experienced many changes during the last two centuries. From highly populated it became one of the least populated, most inhabitants having migrated towards northern industrial towns. The land is poor but it used to be self-sufficient, today however, the main agricultural activity consistent with modern production criteria is raising sheep for milk and cheese.<sup>4</sup> Hence, many changes have prepared the population to adapt and organise particularly well in front of risks and mutations. For instance, in this region, there are a huge number of friendly societies and tiny mutual insurance companies. Many young people from all over Europe came to live on the high plains during the 1970s; the land was inexpensive and returning to country life was the fashion. Most communities collapsed, but many families stayed and are now living on their land; they are very sensitive to environmental, biological, food and social change. The native population is close to the land and aware of the quality of life, food, natural things, etc. It doesn't share the same values with the immigrants, but both groups have the same kind of concerns. The region used to be isolated: rather poor, wild, with a harsh climate and few roads. The construction of a central freeway connecting Amsterdam to Barcelona had, among its collateral goals, breaking the isolation of the area. The axis was nearly completed in 2000, but a last difficulty was still unsolved: crossing the River Tarn's deep canyon. This is what the viaduct achieved in 2005, after many discussions before deciding on: the project, the location of the bridge, the type of construction and, finally, the company to do the work. The population is and has always been concerned and consulted through its elected representatives, trade unions and non-governmental organisations. Its main questions were about:

- Impacts on environment (pollution, noise nuisance, landscape).
- Economic impacts on the town of Millau and on the region.
- New openings and closures of access routes to some valleys distributed by the freeway exits.
- Changes in tourist activities, notably the bridge attractiveness as an art and technological object.

Several studies have been conducted by national organisations as well as by local councils and associations. When one looks at the project's long history, political difficulties are evident. It took 25 years between the first decision on the freeway construction and the last decision on the Millau viaduct. Studies on the crossing of the river and on the type of bridge started in 1988. There were three possible locations: East, Median, West. The Median one was retained after one year. Then, there were two types of project: High or Low. The High one took one more year to decide on, but this option was battled against by several

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<sup>4</sup> The blue cheese "Roquefort" is the most famous among them, and Roquefort is a village close to the viaduct.

organisations on the basis of various arguments. This option imposed a gigantic viaduct (the actual one is 2500 m long, with a platform at 200 m high and central piles of more than 300 m high). Finally, there was a competition among architects and Norman Foster's project won. That was in 1996, the works started in 2002!

One among the many reasons why there was so much delay in the decision-making process is that, at each stage of the discussions, controversies arose about the studies' conclusions and the relative importance of impacts.

As a matter of fact, study conclusions have not always been retained. It began with the first one – performed by a state-dependent consulting company road and transportation specialist, CETE,<sup>5</sup> in Aix-en-Provence, it compared the two types of construction: High or Low. It concluded that the High solution had to be withdrawn because it was geologically too hazardous. Obviously, someone in the Ministry of Transport thought differently and put forward the visibility of the High solution, in contrast with the usual Low solution type of bridge, and that was the one which has been worked on and eventually achieved. This first study concentrated on the technical problems and on geological risks, and it only made a general overview of impacts. It could have been expected that such a technical point of view would have been less controversial and indeed, the Ministry decision took for granted that no one would question its technical expertise. It happened to be wrong, as a “Comité de Propositions pour l'A75”<sup>6</sup> was formed in Millau, under the leadership of a retired engineer (from the same Ministry!), which performed a counter expertise. The conclusion was the same as CETE's, only it went further in the studies, particularly about geological hazards. These are of two kinds: one is relative to the stability of the bridge and had already been put forward by the first study; the other one is relative to ecological impacts. This region is made up of a karst (i.e. soft and hollowed limestone), and serves as a water reservoir and filter to the whole South of France water alimentation. The hazards induced by a heavy bridge and an expectedly important traffic, are relative to infiltrations of polluted matters. The construction weight crackles the rocks and rain water charged with oil, tyre tracks and all kinds of dirt carried by automobile wheels, pours into the cracks and gets mixed up with deep fresh water. Mastery of these hazards imposed more constructions: foundations, consolidations, drains, sewers, etc. and hence higher costs. About costs, the total proposed amount for the construction was €225 m, which was considered highly underestimated by most consultants and opponents to the project. Indeed, another huge bridge above the River Seine (Tancarville), much shorter and lower than this one, cost four times as much, and that was 10 years before! The argument for a lower cost for a bigger bridge was that construction techniques for such bridges are better known, require less qualified workers and some materials are less expensive. In the end, the final estimated cost was €396 m and not only did the contractor accept it, but actually did better (€394 m). We'll come back to this point later on.

It is much more difficult to oppose arguments and compare costs when economic and ecological impacts are studied. This is due, in part, to separations that are usually followed in studies between some types of decision consequences: technical, socio-economic and ecological.

In this book, we'll argue that, up to certain limits, all impacts can be approximately valued, whether by market prices or by individual valuation. Obviously, some valuations may cost

<sup>5</sup> Centre d'Etudes Techniques et de l'Équipement.

<sup>6</sup> Committee for proposals about the A75 (A75 is the name of the freeway).

more to obtain than they are worth to help decision-making. This is one of two reasons why consultants distinguish between types of consequences. Technical implications are accounted for in the range of costs, including future options and additional works. Costs are well known if the delay is not too far away and purveyors are known in advance, they are market values.<sup>7</sup> Economic impacts are easier to value than social issues. However, expertise has set some standards and is able to give a rough idea of the nuisance values, for example. Hence this second type of impact can be quantified and summarised in net monetary benefits. In contrast, ecological impacts, including environmental damages as well as hazards to human activities caused by nature, are much less easy to compute. Furthermore, they are the most likely to be controversial, given that they do not rest on sufficiently reliable scientific studies and that ethical values are different depending on social classes or cultural backgrounds. This is one of the reasons why studies are content with a purely qualitative valuation for this type of consequences. Another reason is more positive: qualitative arguments are much easier to defend in front of an assembly where few experts are present (e.g. elected representatives) than quantitative ones, which are bound to be confused with ethical values. In fact, preparing arguments to be presented in front of representative assemblies is one of the most important tasks of a consultant.<sup>8</sup> Obviously, such a task is based more on political science than on economics, and explains why it is often in contrast to the economic impact valuation. However, missing valuations of such risks deprive the decision-makers of objective criteria for managing them, at least *ex post*, such as insurance or financial instruments able to hedge or compensate possible negative outcomes. In order to apply some of the methods proposed in this book, it is necessary to collect data and generalise enquiries on the public willingness to pay, which are becoming available and gathered by specialised agencies.

In the case of the Millau viaduct example, the best studied impacts were those on the town of Millau and surrounding villages. They address urbanism, regional tourism and environmental issues. Urbanism meant to forecast the possible evolution of industrial plants and surrounding housing and shops implantation, in order to be prepared to open new access roads, streets, sewers and the like. Indeed, access to the freeway and to the bridge implied moving activities from the town centre and from some villages around, towards the access routes. In order to be prepared, it was decided by the town council and other local authorities to modify the road system, refuse dumps and other infrastructures so as to facilitate the probable extensions towards the freeway's access roads. Another bet was on the attraction of the old town centre for tourists who, up to now, were much too bored by traffic jams during the crossing of Millau to consider stopping. This implied advertising and enlarging access roads and parking lots. A third priority was to convince the state and the bridge construction contractor, to leave open most of the construction working roads made for trucks, so that they would provide access to the site, for use as a visiting sight-seeing tour for tourists interested in this major architectural realisation. Tourism is, indeed, a major development factor for the region. Controversies arose about this issue, too. Before the region was opened, tourists were mainly attracted by wildness, old-fashioned farming and sports of nature (canoeing, rock climbing, hiking and more risky sports). Obviously, a technological achievement changes the

<sup>7</sup> Except in centralised countries where arbitrage is flawed by state priorities. Notice that most European countries are still highly centralised as far as infrastructures are concerned.

<sup>8</sup> This was explained to the authors during an interview with one of the chief engineers in the CETE of Aix en Provence in charge of the first study, André Mérieux. The interview was published under the title: "Prévoir l'impact d'un projet d'équipement" (forecast an equipment project), together with a paper of the authors: "L'évaluation des risques dans les projets publics", (risk valuation in public projects), *Economie Publique*, 10 (2002) 9–49.

landscape (the bridge can be seen from miles away) and the general image of the region. The bet, this time, was that this new feature would attract another category of tourists, and would facilitate accessibility to them without repulsing the previous ones too much. There were harsh controversies among the tourist branch about this bet, in particular on the duration of the stays of the waves of Northern Europeans attracted by the Mediterranean coast during the summer and passing over the bridge instead of being delayed by traffic jams. Simulations of different scenarios were implemented by the local tourism organisations, based on past data and on regions that had been through similar modifications. Prospective studies were ordered from consulting firms, but from our knowledge they didn't proceed to enquiries. That made it possible to sketch risks, value them grossly, and help hotels and other tourist activities to orient their investments. Here again, the need for more data has been felt; it would have made it easier to analyse, forecast and get more precise conclusions than could be done with those available. Some could be found in similar regions, but gathering them would require so much work that, again, it necessitates the creation of a special agency.

However, environmental issues were left to expert appreciation and little was done with respect to public perceptions, without opportunities to open discussions about possible alternative scenarios. Therefore, it is not a risk (with both possible gains and losses) but a particular possible damage that is valued. Furthermore, most of the time, impacts are understood in the biased meaning developed for marketing, i.e. positive impacts able to attract customers, that say very little in terms of expected risks! In any case, without monetary valuation of the environmental and visual issues, risk is only appreciated in subjective terms and this leaves little material to think about its management.

It is likely that most great public projects are treated the same way. The discussions have been hard but, deprived of objective arguments about the financial part (except for the technological side), controversies and protests could not lead to much improvement. In the end, it seems that decisions were taken at a high Ministry level, a technocratic level, not a political one, even though the minister signed the decision. Indeed, ministers from all political parties changed over during the long process, and it so happened that it was a Communist minister who signed the most liberal decision! A contract was signed with a private company to build the bridge and a 78-year concession to manage it, including an option to sell!

To what extent is such a decision a collective one? What is the role of individual decisions in such a complex process? In fact, there are several levels at which decisions are taken. Even when an individual actually decides, collective features are taken into account. Take the ultimate stage: when the Minister of Transportation signed the enactment and the contract, he acted as a nation representative and in that sense his decision was the reflection of a collective one. Delegating the work to a private company was certainly not a representation of his own political preferences. He was convinced to do it, because state-owned companies or public services would not have been able to achieve the work for the proposed cost. State-managed entrepreneurs are constrained by many regulations: routine, trade union agreements and heavy administrative costs. Furthermore, they are not very efficient at managing financial risks (the state is its own insurer) and investment profitability. But, if no private companies had taken the challenge to meet the requirements imposed to enter the competition, the state would have had to actually do the job.

A private company is considered economically as an individual agent. Its decision, however, integrates collective choices. First, decisions are taken by a board of directors that represent the owners: they may have different objectives. Second, decisions integrate collective

choice at the national (and even supranational) level, because they are taken under the constraints of regulations and responsibility in front of the law.

It is interesting to learn<sup>9</sup> how this private company analysed the problem. Several reasons explain why it was able to win the competition and achieve the works before the expiration date and at a lower cost than the proposed one. First of all, it had already built several bridges of the same type, although less huge, and it had learned to master the technology. Second, it owns a group of dependent companies who could deal with most of the underwriting tasks: notably a concrete company, a metal works company and several road work companies. That made it possible to lower costs or to integrate them into an overall financial plan. Third, it was able to conduct further studies about climatic and geological risks and make sure it could hedge them financially. Last, the long-term concession and the put option made it able to smooth costs with expected returns and have its image and capital valued by the stock exchange after it achieved this impressive work. A detail worth noticing is that within the interview the word “risk” appears in all the answers, when it is hardly mentioned explicitly in any of the previous studies’ reports. This is because, contrary to a state-dependent company or a consulting firm, such an important international company is not limited to its engineering ability, but is a financial company as well, with an important group of finance and insurance specialists, able to diversify and deal with hedging instruments, which are out of reach of the public ones. Let us conclude about collective choices included in the private decision to take the job: the choice is individual in the sense that it endorses the company responsibility, both financially and legally. However, it integrates collective valuation because it is priced on the stock exchange market, its costs are computed through market values and its financing (bonds and other borrowings) is made at a competitive rate.

In contrast, the first cost valuation was made under the assumption that the state would be in charge of the works, on the basis of materials at then present prices and very low discount rates. This is common practice for state-owned companies and decisions; it is justified in part by the state being its own insurer and investments being managed, *ex post*, by taxes, Treasury bills and discretionary tolls. As a result, its efficiency is hard to compare with private company standards, and the decision is fundamentally of an individual type, even though risks are collectively supported.

The next two chapters should make clear the profound differences in economic theory between individual decisions and collective ones.

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<sup>9</sup> This is taken from an interview with Jean-François Roverato, Board President and Chief Executive of Eiffage, the contractor company, given to a local newspaper: *Le Midi Libre*, special issue, August 2004.

