Feasibility Studies under suspicion: cost/time overrun and low return in construction projects

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SUMMARY

Recent international research show that estimated cost-benefit used in the decision-making process regarding investments in infrastructure projects is usually not very realistic. Frequently, the final costs for the public treasury surpass the costs estimated, in feasibility studies, while foreseen benefits shrink. Serious mistakes in feasibility analysis entail mismanagement of public funds and, therefore cause great damages to taxpayers. This article discusses the main causes for errors in estimates and mechanisms to improve the quality of the decision-making process, regarding investments in large infrastructure projects. In such sense, it discusses the "Reference Class Forecasting" method, developed from theories of Daniel Kahneman, winner of the 2002 Nobel Economics Prize. Furthermore, the article assesses the methods for multicriteria analysis and continuous monitoring of feasibility. In addition, there is the presentation of a case study involving two audits from Tribunal de Contas da União, the Brazilian Federal Court of Audit , which the feasibility of projects. Finally, it presents proposals that increases the accuracy of external control actions, thus, maximizing the real benefits for taxpayers.

Keywords: Public expenditure effectiveness. Feasibility studies. Infrastructure projects. Project management.

1. INTRODUCTION

Large-scale infrastructure projects, whether public works or concessions, generally cost more to the public treasury than initially planned, get late and present a smaller return to society than previously disclosed in its feasibility studies.

In Brazil, we may find countless examples to illustrate such circumstances. For starters, the construction of Nova Transnordestina railway, under a concession regime, is an example of lack of planning and low performance. The project was announced as costing BRL 4.5 billion and with a 2010 deadline. However, by the end of 2016, only 56% of the construction has been completed and the expected cost for the conclusion surpassed BRL 11.2 billion. The construction of the Estádio Nacional Mané Garrincha arena in Brasília serves as another example of a controversial project. Initially estimated at around BRL 750 million, it costed BRL 1.8 billion to taxpayers. For FIFA´s 2014 World Cup arenas the cost spikes from BRL 5 billion to over BRL 8 billion. In addition, some of those sports arenas are currently deemed by critics as "white elephants", since their revenues are not able to cover the maintenance costs. In the oil sector, the situation is not so different – in fact; it is more serious considering the figures involved. . The costs to build the Rio de Janeiro Petrochemical Complex (Comperj) were expected to be around USD 6 billion, but currently surpass the sum of USD 47 billion. These facts, added to the current lack of funds faced by the Federal Government, States and Municipalities, reinforce the idea that public expenditure in large-scale ventures needs to be better planned, used, monitored and audited.

Thus, the purpose of this article is to discuss the quality of public expenditure in the planning and implementation of infrastructure projects. Therefore, we will analyse contracting costs forecasts errors, its causes and mechanisms to improve accuracy in the decision-making process. In this sense, the following methods will be considered: "Reference Class Forecasting", multicriteria analysis for alternative analysis and project feasibility continuous monitoring. As a case study, two audits carried out by the Federal Court of Audit (TCU) shall be presented. Finally, we present proposals for maximizing the effectiveness of external control in the inspection of large-scale enterprises, thus increasing the real benefits for society.

2. ERRORS IN ESTIMATES

Examples of errors in estimates of large developments are not limited to Brazil. Studies subsequent to the conclusion of the Euro Tunnel, a construction connecting the United Kingdom to France via railway, have disclosed serious facts. Its construction cost has increased 80% and its real demand proved to be 50%

smaller than predicted (FLYVBJERG; BRUZELIUS; ROTHENGATTER, 2003). Consequently, the current net amount of the development turned to 17.8 billion Dollars negative, with a negative internal return rate of 14.45%, leading experts to conclude that it would have been best for the British economy if the Euro Tunnel had not been built (ANGUERA, 2006).

Analyzing such enterprise separately, one could think that the loss was just a matter of bad luck. However, the Danish tunnel Great Belt, the second largest underwater tunnel of Europe, opened three years after Euro Tunnel, presented a cost increase of 120%, making the project unfeasible even before it started operations. From an economic point of view, the construction of both tunnels proved to be antieconomic. However, they were implemented because the cost-benefit rates initially presented to investors and politicians were highly inflated, whether willfully or not (FLYVBJERG, 2009). These and other cases of waste of funds led international researchers to thoroughly study the causes for extrapolation of estimated contracting costs and for failure to reach the expected benefits in the feasibility studies for large-scale projects.

A paper titled "Cost Underestimation in Public Works Projects: Error or Lie?" drafted by researchers Flyvbjerg, Holm and Buhl (2002), compared the cost estimates with respective final costs out of a large sample of transportation infrastructure projects. 258 enterprises, totaling investments of a USD 90 billion sum, were analyzed. The final costs were accounted for at the end of the enterprises and the estimated costs were accounted for at the moment of the decision to carry them out. All costs were calculated in the same currency, using historical exchange rate indexes and other statistic data assessment devices.

The analysis has shown, with high statistical significance, that costs were extrapolated on 9 out of 10 infrastructure projects assessed. The final costs were 45% greater than the estimates for railways, 34% for bridges and tunnels and 20% for highways. In general, the final costs were 28% higher than estimates.

Errors in cost assessment were found in twenty nations, spread out through five continents, indicating that it is a global phenomenon. The study has concluded that the cost estimates used in the decision-making process for the implementation of transportation infrastructure projects are systematically erroneous. The same is true for the cost-benefit analysis, given that they base themselves in the cost estimates to assess feasibility and rank the projects. That is, if the estimates are inaccurate, certainly the feasibility analysis are too.

The distortion of cost estimates certainly entails mismanagement of funds, producing losses for those financing public infrastructures, that is, the taxpayers.

> The policy implications are clear: In debates and decision making on whether important transportation infrastructure should be built, those legislators, administrators, investors, media representatives and members of the public who value honest numbers should not trust the cost estimates and cost-benefit analyses produced by project promoters and their analysts. (FLYVBJERG; HOLM; BUHL, 2002, p. 279).

Researchers have emphasized that the conclusions are not an attack on public investments versus private investments in infrastructure, since the analyzed data is insufficient to assess whether private projects presented worse or better data in comparison to public ones. Further, they have warned that the conclusions are not attacks on transportation investments, considering that other large-scale projects also proved to be sensitive to the same errors in decision-making.

3. UNDERSTANDING THE CAUSES FOR ERRORS

Several factors are commonly used as "excuses" to justify performance failures in large-scale projects, for instance, "unforeseen circumstances", "it is a very complex project", "the scope has been altered", "the demand did not materialize", "the economic scenario has changed", "the geological characteristics were unfavorable", etc. Such factors undoubtedly, affect the performance of a development, one way or another. However, are such "unforeseen events" the true causes for planning failure matters? Do failures occur due to bad luck (negative unforeseen events)? In order to clarify the reasons for the lack of accuracy in estimates, some recent researches have tested "technical" (traditional), psychological and political explanations.

Flyvbjerg, Holm and Buhl (2002) point out that the most common explanations are the so-called "technical" ones. These explanations argue that the lack of accuracy is allegedly a result of the usage of unreliable or out-of-date data, of inappropriate forecast models, as well as lack of experience of the planners. However, if that were the real cause for estimate errors, a regular error distribution, with an average close to zero, would be expected, that is, with some equivalence between under and overestimations. As seen in the previous topic, initial estimates are for the most part lower than the final contracting costs, proving that the matter is not related to accuracy. Further, if the imperfection in data and models are the main reasons therefore, an improvement in accuracy, over time due to the development of project management techniques, would be expected, which cannot be seen in the results. This indicates that factors other than poor data and incorrect models are actually responsible for errors in cost-benefit estimates. Pursuant to the abovementioned researchers, psychological and political theories are better suited to explain estimation issues.

Psychological explanations relate the cost-benefit estimates errors to what psychologists call optimism bias. Such bias is a cognitive predisposition in the sense of considering the impacts of future events more favorably and positively than what is demonstrated by previous and current experiences. People, unintentionally, foresee success scenarios and underestimate the potential for errors. Thus, it becomes unlikely that projects be delivered in the set forth deadlines and costs, or that they grant the expected benefits (FLYVBJERG; HOLM; BUHL, 2002).

Political explanations, on the other hand, explain the lack of accuracy in terms of strategic distortion (willful presentation of false data). It occurs when the persons responsible for estimation and managers intentionally and in a strategic manner tend to exaggerate benefits and underestimate costs, so as to increase the probability of their projects being approved or being allotted funds (FLYVBJERG; HOLM; BUHL, 2002). In corruption cases, the matter of stra-

tegic distortion is even more serious. For instance, if a certain corrupt public agent is granted a percentage over the amount of the works as kickback, why would he or she refrain from performing unfeasible or overpriced developments?

Professor Bent Flyvbjerg of Oxford University, in article "Survival of the Unfittest: Why the Worst Infrastructure Gets Built – and What We Can do About it" (2009), states that planners willfully expand success scenarios and hinder failure risks. Pursuant to such explanation, where there is political pressure, there is distortion; but such may be refrained by transparency measures, accountability and strict punishment.

It is important to highlight that the final contracting cost is not necessarily intertwined with the "real" cost of the works. In some cases, cost increases arise from initially unforeseen (whether willfully or not) events. In other cases, part of the accretions may arise from overpricing and corruption practices. The fact is that, by excess of optimism or strategic distortion, the possibility of increases throughout performance is ignored in the moment of decision making in most projects.

In Brazil, the scenario of decision making for investments on large-scale infrastructure projects/programs/policies is even more serious than the mentions collected from international literature. Whether on purpose or not, some billionaire infrastructure investments are decided on without any minimally consistent cost-benefit analysis and without consideration of other alternatives to meet the proposed objectives, or with very superficial studies. As a mere example of this situation, TCU found that the Railway Logistics Investment Program (PIL Ferrovias), launched in August 2012 by the Federal Government, with expected investments around BRL 100 billion, had serious issues in its management and planning, which could compromise the feasibility thereof and cause significant funds mismanagement.

As found in the audit, the weak planning of the program was marked by the lack of studies to base critic decisions. The lack of justification based on technical studies both for the change in the concession model and for the choice and priority of railway stretches caused great uncertainty, increasing the risks of, even after a billionaire investment, the expected reduction on logistic costs not materializing, in addition to the continuation of the unbalance in the transportation matrix and mismanagement of public funds (TCU, 2015a).

4. DEVICES TO IMPROVE QUALITY OF PUBLIC EXPENDITURE

This topic discusses some methodologies to improve the quality of public expenditure in infrastructure. First, it presents "Reference Class Forecasting", a method that improves trust in the initial decision-making process. Then, a method

for multicriteria analysis of alternatives. Finally, examines the need to monitor continuously projects feasibility.

4.1 "REFERENCE CLASS FORECASTING" METHOD

Based on the theories of Daniel Kahneman, winner of the 2002 Nobel Economics Prize, a promising project management method was created in order to minimize the effects of optimism bias and strategic distortion, thus improving the accuracy of the feasibility assessment of enterprises. This method, named "Reference Class Forecasting", has been endorsed by the American Planning Association (APA) and by the United Kingdom Treasury.

Professor Bent Flyvbjerg, on work "From Nobel Prize to Project Management: Getting Risks Right" (2006), explains the main characteristics of such method. The traditional manner of thinking about a complex project is to focus on the project itself and its details ("internal vision"), so as to seek maximum understanding thereof, paying attention to its unique characteristics, trying to predict future events which will influence it. However, this future prediction, with costs and demands, is usually optimistic and may be distorted, as previously discussed. Whereas the "Reference Class Forecasting" method defends a systematic planning analysis based on an "external vision" of the project. Specifically, the method requires the following three steps to improve decision accuracy:

1. Identification of prior similar projects (reference class). The set of information must be comprehensive enough to be of statistical significance;

2. Definition of a probability distribution of cost deviations for the selected reference class in order to allow empirical conclusions;

3. Comparison of the project at hand with the probability distribution of the reference class in order to establish the most likely result for the specific project.

Based on the probability distribution and in the risk accepted by the entrepreneur, the estimated project cost is adjusted for purposes of feasibility analyses only, similarly to a safety coefficient.

To facilitate the understanding of the relevance of "external vision", let us see a hypothetical example. Based on modern schedule management tools, a certain large-scale railway was planned in its feasibility study to be built in two years for the price of X $ per kilometer. However, railways of such size were never built by the institution in less than five years and never at less than 1.8X $ per kilometer. If no material technological revolution has taken place, what would lead anyone to believe that the current project will be more efficient than the previous ones?

It is important to highlight that this method does not replace feasibility studies, nor does it replace the basic project and executive project. In addition, it must be stressed that this method may not be used for project budgeting, considering that historical increases may have been improper (overpricing, corrupt mismanagement, etc.). It is simply a method, which adds an experimental risk analysis, in the decision-making moment, based in previous similar enterprises. That is, it allows the assessment of whether a certain project is feasible, even when contracting costs and benefits are assessed based in previous experiences.

The United Kingdom Department for Transport decided to apply "Reference Class Forecasting" as part of the assessment process for large-scale transportation projects (FLYVBJERG, 2006).

In view of the foregoing, this article argues that a way to improve Brazilian cost-benefit estimates is the supplementation of traditional assessment with an empirical risk analysis, which takes into account prior results of similar projects. For cost-benefit analysis closer to reality, the feasibility assessment of a certain project shall take into account the history of similar past projects. In a simple manner, it may be said that this method works as a type of screening which rejects potentially unfeasible projects.

4.2 MULTICRITERIA ANALYSIS

The cost-benefit analysis is based in the monetization of costs and benefits. However, these parameters may not always be easily adapted. In such cases, the multicriteria analysis turns into an important tool for it allows the weighing of benefits and costs of impacts, which were, not monetized (UNITED KINGDOM, 2009).

The multicriteria analysis aids decision making with regard to a complex matter, weighing factors by

means of weight, allowing the choice of alternatives pursuant to different criteria and points of view (JANNUZZI; MIRANDA; SILVA, 2009).

Recently, this method was defended as an important tool to improve auditing. Article "O uso de geotecnologias como uma nova ferramenta para o controle externo" [*The use of geotechnologies as a new tool for external control*] (FERRAZ et al., 2015) develops the use of a decision model based on multiple criteria, supported by geographic information systems, aimed at the planning of transportation. This type of multicriteria analysis simultaneously integrates distinct variables, combined in groups. Each variable is attributed a weight/points, establishing if the variable is attractive or repulsive for the project in question, as well as levels of attraction or repulsion. Thus, for instance, for a railway or highway outline, stretches with high terrain declivity repeal the outline, for they result in higher building costs; conversely, points with high agricultural and industrial productivity attract the direction of the outline, for they may demand transportation infrastructure. As a result, the model generates themed maps (each variable is plotted in a map) which are combined, so as to identify and quantify the areas of greater feasibility for implementation of the infrastructure.

The tool enables the assessment of several types of public policies consistently and in an interdisciplinary manner. It allows, for instance, the assessment of optimal location for schools, day care centers, hospitals and airports. In the case of linear projects, it allows for the establishment of optimized path outlines for highways, railways, channels and transmission lines, considering technical, economic and environmental characteristics. In addition to that, there are several customizations, which may be developed; amongst them, it is worth to highlight the possibility of monetizing variables and themed maps, so as to create financial surfaces comparable among each other. Finally, this tool allows the indication, in a transparent and objective manner, of the values used during the decision-making process.

4.3 DATA APPROPRIATION AND CONTINUOUS MONITORING

In order to better allocate public expenditure within infrastructure projects, it is important to create a culture of continuous assessment, monitoring and improvement of planning mechanisms.

Psychologist Daniel Kahneman argues that both individuals and groups need mechanisms to review how their decisions were taken. As a researcher, he never accepted the fact companies, which make decisions all the time do not keep record thereof. Thus, they have no means of learning with their own mistakes. Pursuant to Kahneman, that is not accidental, but due to the fact managers do not want to have their mistakes confronted. According to the psychologist, when human reason is left to its own artifices,

it is likely to create several fallacies and systematic errors. In order to make decisions more accurately, he defends that we need to seek solutions to escape such tendencies (KAHNEMAN, 2015).

As emphasized by Daniel Kahneman, it is extremely important to keep record of previous decisions, in order to learn with past errors. In the case of public expenditure, such investment errors should have been clearly demonstrated to the population, as a transparency measure. However, Brazilian public administration entities and agencies do not have the habit of appropriating and disclosing the evolution of the cost-benefit relation regarding large-scale infrastructure projects. That is, they do not produce/disclose studies confronting estimated cost-benefits in feasibility studies (used as justification for the decision to build) with final cost-benefits, so as to prove if the investment was in fact a good deal.

The monitoring of cost-benefit analyses throughout the implementation of the infrastructure project, program or policy is deemed a governance element. The development of operations inherent to public policies shall be constantly monitored and the results thereof periodically assessed, seeking to materialize the set forth objectives and to improve governmental performance. The Guideline for Assessment of Governance in Public Policies [Referencial para Avaliação de Governança em Políticas Públicas], published by TCU, indicates that a public policy (in this context, a public project may also be considered) shall have a routine for following up on its actions, to appraise results and use them to promote improvements in the policy.

Pursuant to the PMBOK Guide, a project management manual and good practices, monitoring shall be carried out from start to finish of a project. It includes the collection, measurement and distribution of information on performance and assessment of trends to apply improvements to the process. Continuous monitoring enables a clear comprehension of the project's "health". Such control includes the establishment of corrective or preventive actions, or replanning. Monitoring encompasses several aspects, such as: comparison of real performance of the project with management plan; identification of new risks, as well as analysis and follow-up of existing risks; among other factors (PMI, 2014).

The importance of monitoring is also related to one of the purposes of continuous cost-benefit analysis: appraising the convenience of continuing with the implementation of the project or the possible need of reformulation, so as to mitigate losses in projects which are no longer feasible throughout their performance. This analysis is especially relevant when it is verified that the premises of the original assessment of the project were substantially changed. Pursuant to PMBOK, the project is ended when its purposes are reached or when the project is terminated because its purposes will or can no longer be reached, or when the need for the project ceases to exist.

It is known that risks and uncertainties are greater at the start of a project, decreasing as decisions are taken and deliveries accepted. Conversely, costs of changes and error correction significantly increase as the project reaches its end.

Obviously, the longer it takes for a certain change in planning to take place, the more expensive it will be. For instance, when a large-scale enterprise is considered unfeasible in the Technical, Economic and Environmental Feasibility Studies (EVTEA), thus being aborted, losses are almost insignificant, such that only the funds applied to drafting the study are lost. If the development is found to be unfeasible during furthering of the studies, for instance, in the basic project stage, the losses increase a little in view of the greater costs with field surveys and assays; however, they are still low. If the development is deemed unfeasible and aborted after start of the works, due to the discovery of extra costs or even the demise of forecast demands, the costs involved shall be exponentially larger. Even more serious would be the case in which the project is completely carried out and, after its conclusion, it is "found" that its benefits barely cover its costs. The worst of all situations certainly takes place when in any of these cases it is found that the revenue of the project does not even cover its maintenance costs, that is, losses grow over time. In this situation, the development's investors/sponsors are extremely damaged, as their funds get drained. In case of public developments, the sponsors are the taxpayers, who witness their tax payments going to waste.

Analysis throughout the life cycle of the enterprise, carried out since preliminary studies, in the basic project, at the start and throughout building, up to the moment of conclusion, enable the appraisal of the good application of public funds, that is, quality of the public expenditure. Reanalysis in initial stages allow the assessment of whether the project must be kept without changes, delayed to a more suitable

moment, changed or even, last case scenario, aborted, when costs surpass benefits.

Considering it is incumbent upon the public manager the burden of proving the good and regular application of funds received from taxpayers, it is imperious that they be stimulated by external control to follow up and monitor the evolution of the cost-benefit relationship regarding investments in infrastructure projects, in a manner transparent to society.

5. AUDITS ON THE FEASIBILITY OF DEVELOPMENTS

5.1 HYPOTHETICAL EXAMPLE OF A COST AND FEASIBILITY ASSESSMENT

Recently, the Courts of Audit have greatly developed the technique of assessing overpricing and overbudgeting on developments, identifying and fighting significant losses to public treasury. However, few of these assess aspects related to the feasibility of infrastructure projects throughout the project's life cycle. Such scenario entails the following reflection: is it enough to assess whether the building price complies with market referentials? Table 1 shows three hypothetical cases.

Upon analysis of the overpricing and estimated return aspects in the feasibility study, "Project A" is the one causing the greatest loss to public treasury, while "Project C" causes none. However, analyzing the real return, after implementation of the development, we see that the losses arising from "Project C" are huge, even with no overpricing, for its return to society is not sufficient to reimburse even half of its costs. Thus, it is important to consider not only the pricing analysis, but also the feasibility of the development.

Pursuant to the International Organization of Supreme Audit Institutions (Intosai), one of the common approaches to performance audits is carrying out cost-benefit and cost-effectiveness analysis (ISSAI, APPENDIX 3000). For such, it enunciates a relevant audit question: "Do the benefits of the Program exceed its costs and are its purposes reached at the lowest cost possible?" (INTOSAI, 2010, p. 90).

In addition, the National Audit Office (NAO) has carried out cost-benefit analysis of the main developments carried out. Some examples of this type of audit can be seen on "Lessons from major rail infrastructure programmes" (2014).

Finally, it is urgent to clarify that this article is not disregarding the importance of market price analysis – on the contrary, it is notorious that such type of analysis assures great real benefits to society, in addition to contributing to the effectiveness and morality of public expenditure. What we are arguing in this article is that, in addition to assessing adherence to referential costs, it is necessary to employ efforts to avoid losses arising from investments in unfeasible enterprises.

5.2 CASE STUDIES

Some recent papers of this Court have furthered the feasibility assessment of developments and investment programs, among which, the cases of Fiol (West-East Integration Railway, under execution by Valec) and Comperj (Rio de Janeiro Petrochemical Complex, under execution by Petrobras) will be mentioned. The first case shows the results of the audit, advising the government to monitor the feasibility of the project in view of the signals of compromise thereof. The second case shows a serious example of mismanagement of funds in the construction of an unfeasible development.

5.2.1 FIOL

In an audit carried out in 2015, TCU assessed issues pertaining to the feasibility of Fiol, planned

Table 1:
Hypothetical example of costs and feasibility assessment

Projects	Overpricing	Return estimated by EVTEA	Real return
A	30%	$2 for each $1 invested	$1.6 for each $1 invested
B	15%	$2 for each $1 invested	$1.2 for each $1 invested
C	0%	$2 for each $1 invested	$0.4 for each $1 invested

to interconnect the municipalities of Ilhéus (BA) to Figueirópolis (TO), and found out that the premises adopted in the study justifying the decision to build the railway were not compatible with actual reality. The Technical, Economic and Environmental Feasibility Study (EVTEA) has not assessed the political, economic and financial risks involved in the implementation of the development. On the contrary, the analysis have presented an optimistic bias and several premises taken into consideration have failed, such as the delivery deadline estimate. The following information is taken from the report and vote of the Decision 2644/2015-Full Court (TCU, 2015b).

According to the study, the 1,500km of the railway should have been operational starting January 2015. However, until July of the same year, not a single operational kilometer was ready, and approximately one third of the railway had not even been bid. At the time, the most optimistic expectations would be to conclude the first leg, "Caetité-Ilhéus", in 2018, whereas the feasibility studies set forth the operation of the leg starting in 2013. In the case of the leg "Barreiras-Caetité", the situation was more serious, with several segments with undefined layout and non-appropriated land.

We found out, in addition to the existence of fabricated schedules, that the main product to be transported by the railway, iron ore, responsible for over 94% of the initial demand set forth in the feasibility study, presented a background of strong devaluation, entailing the revision of investment plans of the local mining companies. Subsequently, this situation entails a relevant increase in the risk of reduction of ore transportation demand (such demand being used as the main reason for the existence of the development). However, these and other changes in the premises of the feasibility study were not being monitored and handled by the government. Thus, the audit indicated that it was not possible to assure the maintenance of feasibility of the railway or some of its segments. That is, there was no real proof that the benefits arising from the implementation of the railway would surpass its costs, which could cause billionaire damages to public treasury.

Considering the significant delays in delivering the project, the downward spike in iron ore pricing, the increase of interest rates and contingency of funds, TCU opinion was that a feasibility assessment regarding the development was needed. Thus, it advised, by Decision 2644/2015-Full Court (TCU, 2015b), that the government reassess the cost-benefit relation with regard to Fiol, considering at least four alternatives, ranging from partial conclusion (operational legs) to the full conclusion of the development. In addition, it recommended studies with the identification, assessment and handling of project risks and the institution of mechanisms to monitor the benefits and costs of the railway.

5.2.2 COMPERJ

In an audit carried out in 2014, TCU characterized the management of Petrobras in the implementation of the construction works of Comperj, one of the biggest developments in the state-owned company's history, as "reckless". The following information is taken from the report and vote of Decision 3090/2014-Full Court (TCU, 2014).

The total cost of Comperj investments, initially estimated in USD 6 billion in 2004, hovered around USD 30 billion in 2012. However, pursuant to the last cost review of Comperj, carried out by the audit in 2014, the amount went up to USD 47 billion. We found out that Petrobras moved forward with the implementation of Comperj in a scenario of high uncertainty, low project maturity and lack of definition with regard to the models of partnerships to be made. In spite of that, the approval of the start of the construction occurred without structured analysis of risks, in total noncompliance with their own applicable internal rules. In fact, there were no studies to assess the probability and impact of risks in order to reach the set forth goals.

The audit report identified the existence of updated internal reports of Petrobras indicating the development's unfeasibility. Pursuant to the audit team, "Comperj's profitability forecast, which, in its initial approval, already proved to be marginally positive, now points to an undeniable propension to economic unfeasibility" (TCU, 2014, n/p). Consequently, the current net amount of the development became USD 9 billion negative. This means that, out of the entire investment made by Petrobras, USD 9 billion will not be returned to the state-owned company until the end of the working life of the development.

Furthermore, according to the audit, the scenario became aggravated upon the verification that the information provided by Petrobras with regard to feasibility of the development was not consistent. The audit found indication that the state-owned company has not accurately disclosed the real investment needs regarding the Comperj Program, for the information presented in multiple media channels proved to be conflicting. What is even more worrying, according to the head of the audit, is "the fact that the discrepancy in information may contribute to erroneous interpretations of Federal Government agencies and institutions responsible for the energy planning of the country" (TCU, 2014, s/p).

In the vote of the abovementioned decision, the Reporting Minister highlighted that

> the inspection is innovative in comparison to others in the enterprise, for it is not restricted to specific contracts, as it aims to identify the main managerial decisions which caused significant impacts to the schedule and budged of the enterprise, as well as to analyze the decision-making process which supported such decisions (TCU, 2014, s/p).

6. CONCLUSION

Serious mistakes in feasibility assessment entail huge losses to taxpayers. However, international literature and national examples demonstrate that cost-benefits estimated during the decision-making process regarding investments in infrastructure projects are systematically unreliable. Thus, routinely the final costs to the public treasury significantly surpass costs estimated in feasibility studies, while benefits usually go down, reducing projects feasibility.

As opposed to the usual excuses, the real causes for failure in project performance, may not be attributed to unforeseen events. They are rather the lack of minimally consistent cost-benefit analysis, the lack of identification and handling of risks, to the excess of optimism in planning and, in a more serious manner, to the strategic distortion of information used during the decision-making process regarding whether to invest.

One way to improve decision making regarding infrastructure investments is the supplementation of the traditional assessment with a risk analysis that takes into consideration the previous performance of similar projects, as described in the "Reference Class Forecasting" method. We must stress that this method may not be used for project budget.

Furthermore, the cost-benefit relation should not be assessed and audited only during the decision-making phase (feasibility study), it must be monitored throughout the life cycle of the project (preliminary studies, basic project, executive project, execution and operation). With reanalysis over time, government may assess if a development shall be kept with no changes, delayed to a more suitable moment, changed or even, last case scenario, aborted, when costs inescapably surpass benefits.

Additionally, the adoption of a better institutional system to halt and counter serious mistakes, including financial, professional and even criminal penalties, would result in the production of more realistic cost estimates.

Finally, it is suggested that government audit play an important role in the cultural change regarding analysis and monitoring of feasibility of infrastructure projects, and on stimulating public managers to apply funds more rationally and efficiently, minimizing the occurrence of unfeasible projects and, subsequently, improving the quality of public expenditure.

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