Cost Overruns and the Proposed Panay-Guimaras-Negros Inter-Island Bridge Project, Philippines

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***Abstract*—Studies have shown that mega transportation infrastructure projects underperform when actual cost and benefits are compared to forecasts utilized in the project proposals. The projected costs have been shown to be commonly underestimated.In this research, a database of transportation projects from the Philippines was assembled to look into the distribution of cost forecast inaccuracies.An ambitious project in the Western Visayas Region is assessed. The Panay-Guimaras-Negros (PGN) Bridge Project intends to connect Panay, Guimaras, and Negros islands via inter-island bridges that span approximately 23 km.In this study, the PGN project is contrasted against previously completed projects and lessons drawn from their experience. Moreover, the Reference Class Forecasting (RCF), as devised by Flyvbjerg, is tackled to improve risk assessment in transportation infrastructure project proposals. If the proposed PGN proposal were placed in the distribution of completed projects based on the databases established, 23% to 55% cost escalation is to be expected when considering 20% risk of cost overrun.This translates to 25% to approximately 33% allotment from the total national public works budget to the proposal. Since the Philippines does not have the recipe for success for this kind of project, caution should be exercised in handling this proposal.**

***Index Terms*—forecast inaccuracies, reference class forecasting, cost underestimation**
[1]

I. Introduction

The Philippines is a developing country which needs to efficiently allocate its limited resources.According to the Department of Budget and Management of the Philippine government, a total of 213.5 billion pesos or approximately 10% of the 2.265 trillion 2014 national budget is allocated to the Department of Public Works and Highways.From this share, approximately 38% is allocated to the regional offices where Region 6 or the Western Visayas region is allotted the second largest share next to the CALABARZON region.

According to statistics, the population of the Philippines is constantly growing at approximately 2% per annum.This means that the road planning sector is under constant pressure from the increasing demand in transportation.The proposed Panay-Guimaras-Negros Bridge Construction Project (PGN Bridge Project) aims to connect the three main islands of the Western Visayas Region namely, Panay, Guimaras, and Negros as seen in Fig. 1.Steel and suspension bridges are to be constructed that would accommodate four-lane roadways [1].Support for this project started way back in 2005 [2]. Recently in 2012, nineteen congressmen from the Visayas issued a joint resolution urging the president to prioritize the PGN Bridge project [3]. The resolution stated that the trans-link bridges will foster new economic opportunities, reduce transportation costs, improve accessibility, and enhance the tourism industry in the region [3]. They also mentioned that the current administration should not only focus its resources in the National Capital Region but also provide assistance for the progress and development of other regions [4]. The lawmakers added that based on the latest census of the National Statistics Office (NSO), the Visayas islands have a larger population than the National Capital Region (NCR).Despite this, the NCR gets the bulk of the national budget. Finally, they expressed that for an archipelagic country like the Philippines, a *unified well-integrated economy* is needed in order for goods and services to be transported efficiently [3].

There have been several studies concerning the PGN Bridge Project.The first study was performed by the Japan International Cooperation Agency (JICA) in 1999.JICA estimated the total cost of the 23.19 km megaproject to be approximately 53 billion pesos.It connects Panay to Guimaras via a 2.59 km bridge while Guimaras is linked to Negros by another 20.6 km bridge [5].In another study in 2010, the Department of Public Works and Highways (DPWH) estimated the total cost of the project to be around 28.5 billion pesos.Unlike the JICA proposal, this study recommended a total of 13.16 km of bridges connecting the three main islands; 3.6 km

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Panay-Guimaras Bridge at 9.44 billion pesos and 9.56 km Guimaras-Negros Bridge at 19.18 billion pesos. In this proposal, the town of Leganes in Iloilo is connected to Buenavista in Guimaras while the town of San Lorenzo in Guimaras is connected to Pulupandan in Negros Occidental [3]. At this time, the proponents of the project has expressed that the PGN Bridge Project is now more realizable due to the smaller amount of funds needed. However, this same study was updated by the DPWH in 2011 and found that the total cost has increased by more than a hundred percent to 54 billion pesos. They also added that there are no funds currently available for the PGN Bridge project [4]. In early 2012, the local government coordinator for the project had a meeting with the same consultant that conducted the study in 2008 [6].This shows the amount of interest in the project where project proponents have also looked into several sources of funding, from Public-Private Partnership (PPP) to Official Development Assistance (ODA) and JICA [2]. The PGN project is also included in the Western Visayas Regional Development Plan as a Major Inter-District or Regionwide Proposed Infrastructure Programs for 2011 to 2016 [7].

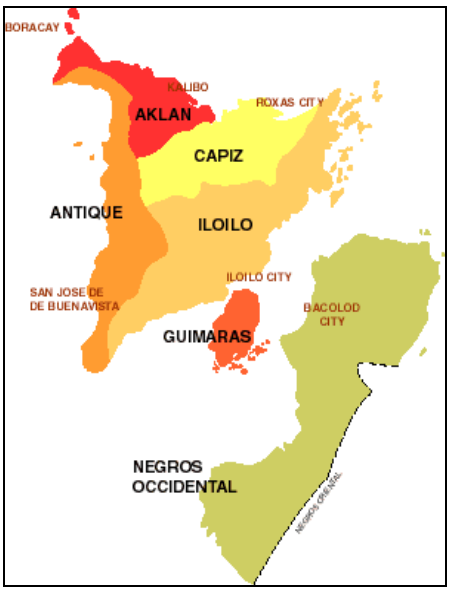

Figure 1. Map of western visayas region, philippines

This study looks into the proposed PGN bridge project, a project which will definitely put the region on the limelight when it is fully realized. However, the evaluation of the project through cost-benefit analysis should first be examined. It has been mentioned in previous studies that most projects of this scale fail and therefore, no matter how prudent the estimates are calculated, human bias is still incorporated. Studies in the past have also shown that there are cases where forecasts are manipulated where the real and unbiased information behind the projects are kept from the public. This is done in order to get the project approved.

This research intends to place the PGN project in the distribution of previously completed projects of the same scale from which lessons may be drawn from their experiences. Moreover, the RCF, as devised by Flyvbjerg, is tackled in order to improve risk assessment in transportation infrastructure project proposals, such as the proposed PGN project. By using this technique, the human bias incorporated in the forecasts may be eliminated or at least minimized.

II. Literature Review

Industrialization and progress are supplemented by costly infrastructure projects with the envisioned purpose of acting as catalysts for growth and development of nations. However, as more of these projects are built, much resource is being wasted, due to the poor performance of these expensive projects [8]-[10]. Flyvbjerg mentioned that the best practice in the field of megaproject planning and forecasting may be thought of as an outlier while disasters are the norm [11]. The problems caused by these projects are very intricate and influential that much attention is needed in the planning of such risky endeavors [12]. Proper monitoring, evaluation, and international comparison are needed to identify which projects comply with the demand forecast, cost forecast, and other projected impacts [13]-[15]. Proficient planning complemented by ethical politicians, planners, and project proponents will result in improved decision making; therefore, projects that deserve to be built are built and those that do not, will be abandoned.

A problem observable in the field of transportation is the strong influence of politics in the planning and approval of projects [10], [16], [17]. Increase in politics entails more competition. This sort of competition, especially with regard to public funds, drives project proponents to carefully manipulate their project proposals in order to outdo other proposals. Blown up figures shown in the proposals appear attractive to the decision makers. However, these forecasts are biased where the real and unbiased information behind the projects are kept from the public. All of these result in less cooperation among government units and the professional expertise of consultants are often ignored due to fact that projects are habitually evaluated through political influence of the proponents or through the personal monetary benefits, gains, or bribes obtained from each of the projects [10], [17]. Inefficient decisions are thus often carried out.

Due to the long planning stages of megaprojects, Flyvbjerg has shown that these projects are risky, both in terms of revenue and economics where managers often cited that poor forecasting, poor risk identification, and cost escalation are the main reasons for exceeding the budget. The transportation projects in Flyvbjerg's database, distributed all over the world, have costs varying from $1.5 million to $8.5 billion. Out of all these projecst, 86% of the 258 transportation projects in his database, suffered cost overruns. Table I shows some results of the study by Flyvbjerg [18]. It indicates that for any kind of transportation project, a 27.6% cost escalation is expected to be experienced, on the average. Reference [19] have also made a study identifyingsome of the causes of cost overruns in transportation projects in Asia.

TABLE I. AVERAGE COST ESCALATION IN 258 TRANSPORTATION INFRASTRUCTURE PROJECTS, IN CONSTANT PRICES (FLYVBJERG, 2007)

Project type	Number of projects (n)	Quartiles (25/50/75%)	Average cost escalation (%)	Standard deviation
Rail	58	24/43/60	44.7	38.4
Bridges and tunnels	33	-1/22/35	33.8	62.4
Roads	167	5/15/32	20.4	29.9
All projects	258	5/20/35	27.6	38.7

III. METHODOLOGY

With the results from previous studies concerning the cost overruns and demand shortfalls of transportation megaprojects, a project like the PGN bridge project should receive the necessary precautions with regard to its cost and performance. The proposed PGN Bridge Project may be considered a megaproject due to its enormous size and the colossal capital investment required. It rivals those international projects deemed to be huge. The cost of the PGN project is estimated to be between 28.5 billion PHP or $631.8 million (1USD: 45.11PHP) in 2010 and 54 billion PHP or $1.25 billion (1USD: 43.31PHP) in 2011.It has been supported in the Philippine Congress since 2005 pioneered by a JICA project study made in 1999.

The cost-benefit analyses are based on forecasts and depend much on the assumptions formulated. However, no matter what advanced modelling tools are used, some degree of optimism bias is incorporated in the forecasts. In order to avoid this, Flyvbjerg advocated the use of his RCF technique. It is a method which takes the *outside view* of the specific project being evaluated. It looks into the results of a similar class of previously completed projects, thus avoiding the stages in planning where bias may be incorporated [20].The method consists of the following three steps [21]:

- Identify a similar reference class of completed projects which is comparable to the project being evaluated.
- Establish a probability distribution for the reference class with a sufficient number of samples.
- Compare the project with the established distribution and predict the most probable outcome for the project being evaluated.

This is the same method employed for this research.

IV. DATA COLLECTION

Annual reports, ex-post evaluations, and materials from other similar studies were assembled in order to acquire more knowledge in the field of study. The websites of international funding organizations such as JICA, JBIC, ADB, and World Bank were checked for prospected local projects to be included in the database. The archives of government agencies such as the Department of Transportation and Communications (DOTC), Department of Public Works and Highways (DPWH), and Toll Regulatory Board (TRB) were also explored in order to obtain the necessary information on completed projects in the country. These transport agencies in the Philippines were visited and the necessary project documents were obtained to form the database.

Through the gathered information on actual and projected costs of the transportation projects, magnitude and frequency of cost forecast inaccuracies were determined. The results from the statistical analyses of this study were related to the proposed PGN project. Establishing a database of transportation infrastructure projects for the Philippines proved to be difficult due to scarcity of data and limited resources; thus, the sample points were incorporated based on data availability. Majority of the data gathered includes only the forecasted cost, the details of the planned projects, and actual cost. The details of the projects after completion were not included in the reports acquired for this study. This information could have given further evidence as to whether the plans and specifications of the completed projects were fully realized or not. This could have provided further insights on the magnitude and direction of the cost forecast inaccuracies derived.

V. RESULTS AND DISCUSSION

A total of 85 transportation projects were gathered to form the database of transportation projects in the Philippines. The histogram of the cost overruns from the transportation projects in the Philippines is shown in Fig. 2. It can be verified that more than half of the projects in the database suffered from cost overruns, as indicated by the positive values.

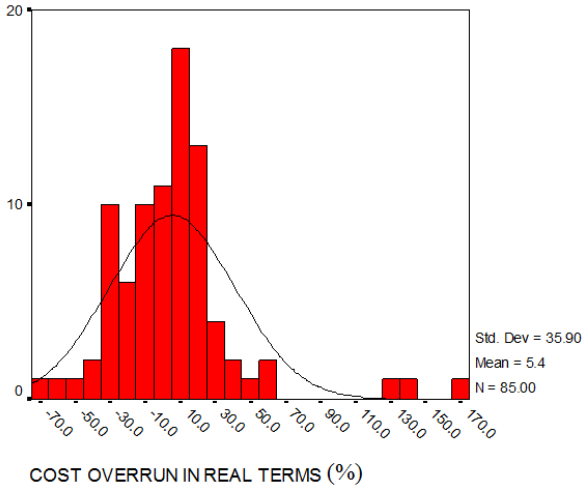

Figure 2. Cost overrun in transportation projects in the Philippines, in percent.

In order to analyze the trend of forecast inaccuracies through the years, the respective deviations were plotted against the year the forecasts were made.As shown in Fig. 3, the year the cost forecasts were made somehow influences the magnitude of cost overruns incurred by the transportation projects.It seems that the cost forecast inaccuracies have a slightly increasing trend which is quite noticeable between 1990 and 2004.Despite the advances in computing tools and techniques, the accuracy of forecasts do not improve with time.

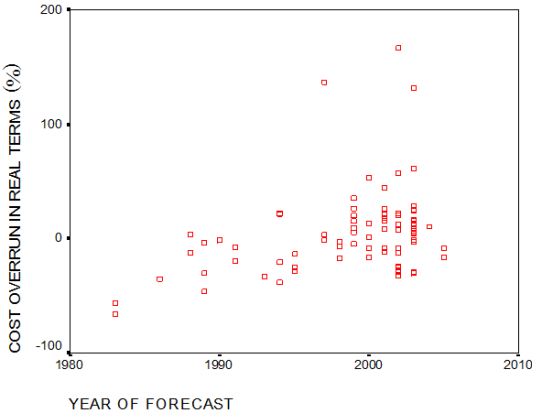

Figure 3. Scatterplot of cost overrun vs year of forecast in Philippine Projects.

Out of the 85 transportation projects, 60 are road projects and 25 are bridge projects costing between 49.5 million PHP ($2.05 million) and 12.7 billion ($524.22 million), far smaller in project size than Flyvbjerg's database. Table II shows that the mean cost overrun of bridges is larger than that of road projects. Despite the small values of cost overruns, the standard deviation values for costs are significantly large, indicating uncertainty. Only the cost data were noted as there were no actual demand records kept for transportation projects in the Philippines.

TABLE II. AVERAGE COST ESCALATION IN 85 PHILIPPINE TRANSPORTATION INFRASTRUCTURE PROJECTS, IN CONSTANT PRICES

Project type	Number of projects (n)	Average cost escalation (%)	Standard deviation
Road	60	2.70	36.21
Bridges	25	11.91	35.02
ALL	85	5.40	35.90

The distribution of cost overruns in bridge projects in the Philippines is shown in Fig. 4. A class specific to bridges iscategorized separately for the purpose of this study in order for the identified reference class to be more comparable to the proposed PGN project.Based on Fig. 4, 60% of all the bridge projects experienced cost overruns.The maximum error computed was 132%.From the 25 bridge projects, approximately 33% experienced overruns of 20% or more while 16% recorded inaccuracies of more than 40%.

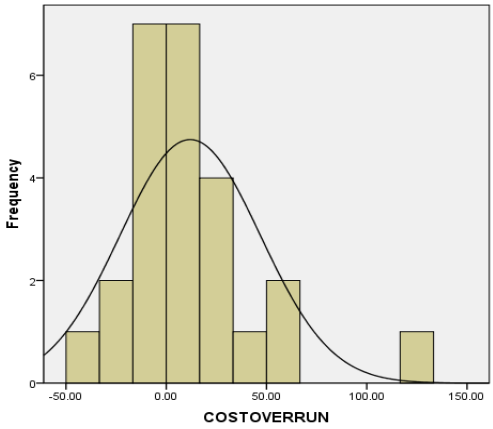

Figure 4. Cost overrun in Philippine bridge projects.

The required increase in the forecasted cost of a bridge project is then derived from these results. Fig. 5 shows the required increase in budget for a certain level of cost overrun. It can be verified that for a 50% chance of cost overrun, about 12% of the forecasted cost should be added, while at a 10% level of risk, the required uplift is approximately 60%, in constant prices.

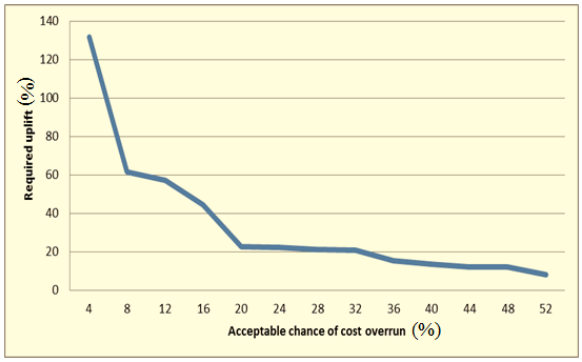

Figure 5.Required uplift as a function of the maximum acceptable level of risk for cost overrun, bridges in the Philippines.

The different values of budget increase shown in Fig. 5 differ in magnitude than the results of Flyvbjerg. The results from the two studies are contrasted in Fig. 6 where an approximated curve from the results of Flyvbjerg is superimposed over the result of the current study. Clearly, the budget uplifts in the current study are less than those estimated by Flyvbjerg. There are a number of factors that may influence the difference in results. The difference may possibly be caused by the size of the projects included in the database. The projects in the current database are far smaller than those in the Flyvbjerg database. Another reason may be caused by the funding mechanism in various countries or maybe the different influences caused by diverse political and institutional arrangements in different geographical locations.

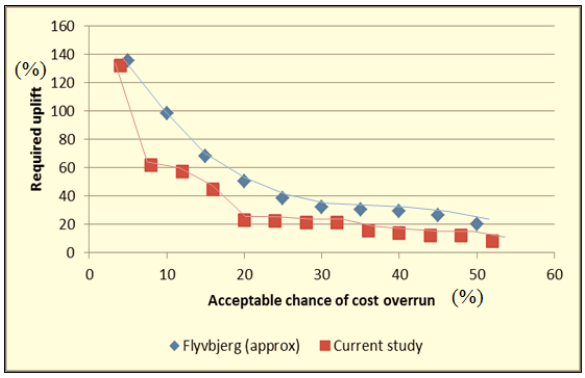

Figure 6. Comparison of the required budget uplift.

Despite the differences in the required increase in budget for bridge projects, the study of Flyvbjerg and the current study agree that most transportation projects almost always exceed their allocated budget for various reasons. This fact when coupled with the underperformance of projects reported in other studies, in terms of revenue, results in significant losses. Therefore, a project in its planning stage should be subjected to the

RCF modelling technique. This way, a more realistic cost projection based on the performance of previously completed projects is derived. These values may then be used in the analyses so that a proposal may be evaluated more accurately and truthfully. Therefore, projects proposals that deserve to be built are built, while those that do not, are rejected.

The PGN bridge project costs 54 billion PHP or $1.25 billion (1USD: 43.31PHP) according to the latest cost forecast. If it is subjected to the RCF technique, then the projected cost may be expected to increase by the amounts indicated in Table III. In case a 20% level of risk is acceptable for the project proponents, then the expected amount should be increased by 23%, in real terms, instead of the original estimate of 54 billion pesos. However, when the results of Flyvbjerg are applied to the PGN proposal, a 55% increase in budget is necessary for a 20% acceptable risk level.

Note that the results of Flyvbjerg are also considered and given ample consideration since the projects in his database are comparable with the proposed PGN bridge project in terms of cost and size. The maximum cost in the current database is only 17 billion PHP which is just one third of the forecasted cost of the PGN project. This is the reason why the results of Flyvbjerg were also considered. Moreover, it is important to compare local results with other countries since lessons may be drawn from their experience, as suggested by other researchers. In the case of the Philippines, such a massive undertaking like the PGN project, a true megaproject, is very rare to be approved and constructed. To date, only one project may be considered a megaproject, the light rail line extension which has just been approved and construction yet to start. If in case the PGN Project gets the approval, it is best to prepare and plan for the worst and where else can the Philippines learn and compare the project with but from the familiarity of other countries in such ventures.

TABLE III. PGN PROJECT PROPOSAL BUDGET UPLIFTS FOR A CERTAIN ACCEPTABLE LEVEL OF RISK

Database	Acceptable level of risk			
	50%		20%	
Philippines	+10%	5.4B PHP ($124.68M)	+23%	12.4B PHP ($286.31M)
Flyvbjerg	+23%	12.4B PHP ($286.31M)	+55%	29.7B PHP ($685.75M)

Given these results, the cost-benefit analysis of the PGN bridge project, and the other proposed local projects, should reflect the adjusted costs as suggested by the RCF technique. The more truthful cost may now be contrasted against the benefits and hence a better evaluation of transportation project proposals can be implemented. Doing so will reduce the economic risks associated with such costly investments that represent a significant proportion of the national budget for public infrastructure provision.

VI. CONCLUSION

In this research, the long experience of other countries in constructing megaprojects has been reviewed. Flyvbjerg, through his large database of transportation megaprojects, has well illustrated the landscape of megaprojects construction.He disclosed that around 90% of the projects experience cost overruns where up to 50% overruns are common and greater than 50% are not uncommon. He also noted that cost overruns have been constantly high for the 70-year period all over the world. On the other hand, he revealed that benefits are overestimated making megaprojects risky on two fronts.He suggested the implementation of the RCF technique in the project proposal stage of such projects. In this regard, if in case the PGN project proposal becomes a full blown feasibility study, the RCF technique should be employed in order to get the risk assessment right.

The PGN project has been studied by JICA and DPWH with varying projected costs and designs. The costs range from 53 billion pesos in 1999, 28.5 billion in 2010, and 54 billion in 2011.This just reflects the uncertainties in cost estimation for this kind of project. Different designs and alignments have different associated costs, but even if everything has been finalized, there is still no guarantee that costs will not change. Unforeseen problems will be encountered along the way, and together with these problems are unpredicted cost adjustments that pile up resulting in large cost overruns. The Philippines does not have any experience in constructing a project of such magnitude. Thus, we have no formula for success, just like most of the other failed projects completed in the past. Furthermore, Flyvbjerg mentioned that it is easier to enumerate projects that failed than projects which have succeeded. Therefore, it does not look promising and all the more the need to look into the experience of others in megaproject construction.It is clear that the effects of megaproject provision are extensive. If the megaproject construction fails, which is highly probable, other sectors are getting adversely affected.

The project proponents and the national government should justify the necessity for the proposed PGN project. The 54 billion peso current estimated cost is 25% of the DPWH national budget. If a 20% acceptable level of risk is adopted, then the PGN project will expend approximately up to one-third of the national DPWH allocation since a 23% increase on the original project cost will be added; the national budget will for certain be severely affected. Private capital through PPP could help obtain funding. However, even with the use of private capital, the risks involved do not change and therefore, the same amount of caution should be employed.

Now that the scale of risk in the provision of megaprojects has been exposed, questions about the PGN project proposal may be posed. Does the region, or the Philippines, urgently need it? Have the basic needs of the constituents been provided for, that this project will be prioritized? It has been mentioned that infrastructure provision is a way of delivering service to the people. However, for the case of the PGN project like the other megaprojects that have been built, it is more of a risk due

to the fact that large standard deviations exist for both cost overruns and benefit shortfalls in megaproject construction. Let the experience of the other countries serve as a reminder of just how much uncertainty exists despite extensive planning. It is with great advice that in planning such projects, forecasting with care and truthfulness be accomplished by moral proponents and planners.

Aside from the cost of the projects, it is important that the demand aspect is examined as well. In this study, only the cost forecast inaccuracies were discussed. This is due to the fact that in the data gathering phase, only forecasted cost, actual cost, and forecasted demand were available for completed transportation infrastructure projects. There were no project evaluations made to check the performance of the completed project in terms of demand. Such a shortcoming in the monitoring of projects makes it impossible to estimate and prepare for a probable demand underperformance. It is suggested that the performance of completed projects be checked correspondingly based on the forecasts included in their project proposals.

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