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FORECASTING INACCURACIES IN TRANSPORTATION PROJECTS IN SELECTED SOUTH EAST ASIAN COUNTRIES

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Civil Engineering
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ผลการศึกษาในอดีตที่ผ่านมาแสดงให้เห็นว่าโครงการด้านโครงสร้างพื้นฐานการขนส่ง เช่น ถนน และสะพาน มักพบว่ามีความผิดพลาดของการคาดการณ์ค่าต่างๆ ที่ทำไว้ก่อนการก่อสร้าง โดยต้นทุนในการก่อสร้างที่ได้ประมาณการณ์ไว้มักจะต่ำกว่าต้นทุนจริง ส่วนปริมาณการจราจรที่คาดการณ์สูงกว่าปริมาณที่เกิดขึ้นจริง ในงานวิจัยนี้ ฐานข้อมูลของโครงการด้านโครงสร้างพื้นฐานการขนส่งสำหรับประเทศไทยและฟิลิปปินส์ ได้ถูกจัดทำขึ้นเพื่อตรวจสอบความไม่เที่ยงตรงของการประมาณการณ์ต้นทุนของโครงการในภูมิภาคนี้ แหล่งข้อมูลที่ได้ทำการรวบรวมในการศึกษานี้รวมถึงรายงานการศึกษาความเป็นไปได้ สถิติอย่างเป็นทางการ และรายงานประจำปีของหน่วยงานช่วยเหลือระหว่างประเทศ และหน่วยงานด้านการขนส่งของรัฐ ข้อมูลจากทั้งหมด 135 โครงการซึ่งประกอบด้วยทั้งต้นทุนที่ได้คาดการณ์และต้นทุนจริงได้ที่ถูกรวบรวมไว้ในฐานข้อมูล จากผลการวิเคราะห์ข้อมูล ไม่พบข้อแตกต่างของความคาดเคลื่อนในการประมาณการณ์ต้นทุนระหว่างโครงการถนนและโครงการสะพาน อย่างไรก็ตาม ความคลาดเคลื่อนดังกล่าวของโครงการในประเทศไทยและประเทศฟิลิปปินส์นั้นมีขนาดแตกต่างกันอย่างมีนัยสำคัญ ระดับความรุนแรงและความถี่ของความคาดเคลื่อนในการคาดการณ์ต้นทุนก็ได้รับการตรวจสอบด้วย พบว่าจากโครงการทั้งหมด 135 โครงการ ร้อยละ 41 พบว่าต้นทุนจริงสูงกว่าต้นทุนที่ประมาณการณ์ไว้ ซึ่งน้อยกว่าค่าที่พบในผลจากการศึกษาในอดีต คือ ร้อยละ 90 อย่างมาก นอกจากนี้ ขนาดของความผิดพลาดของการประมาณการณ์ต้นทุนสำหรับโครงการในภูมิภาคนี้ก็มีค่าต่ำกว่าที่พบจากการศึกษาในอดีตอีกด้วย แม้ว่าผลการศึกษานี้จะมีส่วนช่วยในการพัฒนาวิธีการคาดการณ์ต้นทุนสำหรับโครงการด้านการขนส่งในภูมิภาคเอเชียตะวันออกเฉียงใต้ แต่การนำไปใช้และการตีความผลการศึกษานั้นควรจะต้องทำด้วยความระมัดระวัง เนื่องจากกลุ่มตัวอย่างของการศึกษามีขนาดเล็ก และรูปแบบของโครงการด้านการขนส่งที่ทำการศึกษามีอยู่จำกัด ฐานข้อมูลขนาดใหญ่ขึ้นและมีความหลากหลายมากขึ้นนั้นมีความจำเป็นเพื่อที่จะสะท้อนลักษณะของความถูกต้องของการคาดการณ์สำหรับโครงการด้านการขนส่งในภูมิภาคนี้

ภาควิชา : วิศวกรรมโยธา ลายมือชื่อนิสิต: ....

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NICANOR ROXAS, JR. : FORECASTING INACCURACIES IN TRANSPORTATION PROJECTS IN SELECTED SOUTH EAST ASIAN COUNTRIES. THESIS ADVISOR: ASSISTANT. PROFESSOR SAKSITH CHALERMPONG, pp. 113

Past studies show that transportation infrastructure projects, such as roads and bridges, often perform poorly as compared to the forecasts made before they were constructed in that projected costs are underestimated while forecasted demand are overestimated. In this research, a database of transportation infrastructure projects from Thailand and the Philippines was assembled in order to verify whether inaccuracies in cost forecasts exist in the region. The sources of data that were compiled in this study include feasibility studies, official statistics, and annual reports of international aid agencies and government's transportation authorities. A total of 135 road and bridge projects, complete with forecasted and actual costs were included in the database. From the results of the analysis, it has been verified that there are no significant differences in cost forecast errors between road and bridge projects. However, the errors found in transportation projects in Thailand are significantly different in magnitude from those in the Philippines. The level and frequency of cost forecast errors in the three countries were also examined as well. Out of the 135 transportation projects, 41% experience cost overruns, much lower than the result of a previous study which is 90%. Moreover, the magnitudes of cost overruns experienced in the region are smaller than those in the previous studies. Although the findings of this study can contribute in improving the method of cost forecasting in the South East Asian region, they should be used and interpreted with caution because of the small sample size of the study and the limited types of projects that were considered. A larger and more diverse database is needed in order to better represent the true condition of the accuracy of forecasts in the region.

Department :	Civil Engineering	Student's Signature:	
Field of Study :	Civil Engineering	Adviser's Signature:	
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CHAPTER I

INTRODUCTION

This chapter gives an overview of what this research is all about. The statement of the problem, the objectives of the study, and hypothesis are all presented in this chapter.

1.1. Background of the Study

The Second Stage Expressway in Thailand, the SMART Tunnel in Malaysia, and the MRT3 in the Philippines are some of the transportation projects that are enormous in size and costly to construct. Past studies show that projects of this magnitude often perform poorly as compared to the forecasts made before they were constructed in that projected costs are underestimated while forecasted demand are overestimated (Anguera, 2006; Gómez-Ibáñez, 2000; Flyvbjerg, 2003; Wachs, 1987). Such inaccuracies have been persistent over the years despite advancements in forecasting methods and techniques (Flyvbjerg et al., 2003).

This research followed the approach adopted by Flyvbjerg. The researcher focused on the forecast inaccuracies in transportation projects found in South East Asia. Specifically, the researcher examined completed transportation infrastructure projects in selected countries and performed analyses on cost and demand data, both projected and actual, of these projects, explained what possibly went wrong in the forecasting methods, and suggested ways by which they can be improved.

1.2. Statement of the problem

Do systematic cost underestimation and demand overestimation exist in transportation projects in South East Asia and how do the errors found in this region compare to those found in the previous studies? In this study, a database of cost and demand, both projected and actual, of transportation infrastructure projects in South East Asia was constructed and analyzed in order to verify whether forecast inaccuracies in such projects exist in the region. The database generated was then used as the basis for the application of the *Reference Class Forecasting Technique, (RCF)*, proposed by Flyvbjerg. Using this method, the forecaster looks to the distribution of forecasting inaccuracies in the set of projects that are deemed similar to the project in question; i.e. in the same "reference class", and use that as a basis on which the forecasted figures of demand and costs are adjusted in order to allow for the probable inaccuracies that will occur (Flyvbjerg, 2006). This method has shown potential in improving forecasting results over those of conventional forecasting techniques.

Applicability of the method depends largely on data sufficiency. *RCF* can only be performed when adequate data has been gathered about the actual and estimated demand and cost of projects. This method requires three steps and it is the first step that dictates whether the technique can be applied. This involves determining relevant reference class of projects that is *"broad enough to be statistically significant but narrow enough to be truly comparable with"* the project in question (Flyvbjerg, 2006). In the case where there is insufficient data for *RCF*, the missing key information regarding transportation projects were addressed in order to allow for systematic international comparisons of projects and future studies such as this research. In addition to this, the researcher answered some underlying subproblems such as the size and frequency of the forecast inaccuracies in South East Asia, the differences in the magnitude and frequency of forecast inaccuracies across different project types and location, the probable causes of inaccuracy in forecasts, and the measures that can be employed to alleviate such problems.

1.3. Objectives

1.3.1. To verify whether systematic forecast inaccuracies in transportation projects exist in selected countries of the South East Asian region.

1.3.2. To test the applicability of the RCF method in the case of SEA.

1.3.3. To address the missing key information regarding project evaluations in order to allow systematic comparisons of projects in the case where RCF is not applicable.

1.4. Hypothesis

A lot of transportation infrastructure projects have been planned and completed around the world. Previous studies indicate that the demand and cost forecasts do not match with the actual figures (Flyvbjerg, 2003; Wachs, 1987; Anguera, 2006; Gómez-Ibáñez, 2000). Such inaccuracies have been haunting the transportation sector for decades (Flyvbjerg, 2003). Errors in forecasting the demand and cost for transportation infrastructure projects can be attributed to many factors.

Demand and cost forecast inaccuracies may exist in South East Asia as well as anywhere else in the world. However, the magnitude may not be as pronounced as those found in developed countries. Numerous reasons bring about this disparity. The differences in how projects are planned, funded, evaluated, and decided, all influence such inaccuracies. We expect the inaccuracies here in South East Asia to be less than those found in developed countries, especially for rail projects. Also, if the project will be planned, evaluated, and funded by foreign institutions, the researcher expects the inaccuracies to be less pronounced, that no systematic errors in forecasts are present, and that cost and demand projections are unbiased. These are due to the fact that there are less incentives or no incentives at all, for the foreign agencies to manipulate the figures in the project proposals.

The RCF technique is expected to yield more accurate results compared to the traditional forecasting methods since it averts the stages where human bias may be incorporated. RCF has also proven to have an edge over traditional forecasting tools especially in non-routine projects (Flyvbjerg, 2006). RCF is also cost efficient and less time consuming than other types of forecasting methods since less effort is put in data gathering and analysis phases of the investigation.

1.5. Significance of the Study

This research aims to examine the flaws in the transportation project feasibility studies which result in erroneous forecasts. With the problems exposed, possible solutions can then be formulated and suggested to politicians, project proponents, and analysts. Improvements in the planning practices will yield more accurate forecasts. Such estimates are significant in order to make informed decisions regarding the proposed projects, whether they are to be pushed through or not. Valuable lessons can also be learned from the comparison of different planning techniques from various countries. It will highlight the strengths and weaknesses of each technique therefore the more appropriate policies can be applied at the right circumstances. Since a database of previously undertaken construction projects in South East Asia will be established, it will be possible to learn from the other developing countries in the region. Lastly, if the database of transportation projects will permit the application of the RCF technique, the optimum bias uplifts that can be established will aid in the evaluation of project proposals and thus, consider the risks appropriately.

1.6. Expected Outcome

1.6.1. A database of demand or cost of transportation projects in South East Asia as well as other important project specific characteristics.

1.6.2. Bias uplifts for transportation projects, only if RCF can be performed.

1.6.3. A list of missing key information, where necessary, in transportation project evaluations necessary for the application of RCF in the region.

1.7. Assumptions

The assumptions used in this research are as follows:

1.7.1. The data acquired from the different departments and companies are unmodified.

1.7.2. Bridges and other elevated projects are considered bridge projects.

1.7.3. Road projects include new links, bypasses, maintenance, and expansion projects.

1.7.4. The year of completion of the project was assumed as the year when the actual cost was computed.

1.7.5. The year of forecast was assumed as the year when the decision to construct the project was made.

1.8. Scope and Limitations

The transportation projects dealt with in this research are all from selected countries in the South East Asian region such as Indonesia, Thailand, and the Philippines. They are transportation infrastructure projects, such as roads and bridges, which are significant in productivity improvement and economic development of the country. The data of transportation projects included in the database of this study are all gathered from government agencies such as the DOH in Thailand, DPWH and DOTC in the Philippines, and other foreign institutions such as JBIC, ADB, and JICA. This study focuses on the inaccuracies in cost forecasts only.

The database included in this research is limited to those projects with forecasted and post-opening data. Transportation projects with this kind of data are hard to find so the sample size may be small thus, the sample may not be representative of the population. Also, since the data are obtained from agencies mentioned earlier, projects with poor performance may not be disclosed to the researcher. Lastly, due to confidentiality reasons, projects such as PPP may not be well represented in the database.

CHAPTER II
LITERATURE REVIEW

Several articles related to this research are discussed in this chapter. Topics such as the planning process, politics and governance, forecast inaccuracies, and international planning practice are all reviewed in detail.

2.1. Planning Process

In Oades and Dimitriou (2007), the authors argued that mega urban transport projects aid in uplifting the current economic and social condition of the region, even the whole country. However, despite the fact that so many projects of this kind have already been completed, matters regarding costs, impacts, and demand still raise concerns. The problems that arise in such projects are very intricate in the sense that complex interactions exist among the numerous components involved in the project. Oades and Dimitriou claimed that methods and theories are helpful in certain fields but cannot predict the social, environmental, and economic effects of projects. Numerous explanations can be adopted for the same problem and solutions may take any form depending on the assumptions and explanations one chooses. They concluded that more data from larger and more diverse sources are needed to identify and learn the foundations for successful projects; broader participation of major stakeholders and lessons learned should be incorporated in planning future projects.

In Wachs (1987), the author dealt with demand and cost forecasts for rail projects in the USA. He stated that transportation projects across the USA such as the Miami subway, Baltimore subway, Bay Area Rapid Transit (BART), and Washington Metro have actual demand volumes which are way below the forecasted values. He also added that the combination of demand shortfalls and cost overruns resulted in an increased cost per passenger which is about four to twelve times than those of forecasted values. This translates to economic and social losses and thus, inefficient use of public funds. The author cited two possible reasons for these forecasting errors. He first stated that "*forecasts are inherently inexact and* *that the observed errors result from imperfect techniques"* while the second hypothesis is that "*travel and cost forecasting is deliberately slanted to produce figures which constitute technical justification for public works programs favored on the basis of political rather than economic or technical criteria*." The first hypothesis can only be true if there is inadequate experience in this kind of projects. However, a lot of infrastructures have already been completed and records show that costs are almost always underestimated while ridership is always overestimated. It seems that the second hypothesis is more logical. If there were weaknesses in the techniques used in forecasting, then these should have already been addressed and improved by now due to numerous previous experiences in the field. The author also pointed out that the USA has a system in which rail projects are funded through a discretionary program. State officials then try to get as much as 75% funding from the federal government for a new transit system. This means that states are continually competing for rail funds making this field in transportation very competitive and politicized. Cost and demand forecasts thus play an important factor in the allocation of federal subsidies for rail projects. Because each city or state is competing with others, they try to make their proposals as more attractive as possible. They present it in such a way that their scheme is the most cost-effective choice among all other proposed projects. "*A low cost estimate makes a project appear to be more cost-effective than its competitors while a more conservative cost estimate might result in the loss of the entire project*," the author added. It seems that there is an incentive in providing very optimistic and biased forecasts for ridership and costs rather than conservative estimates.

According to Martin Wachs, the sequential four-step model is the typical method by which forecasters use in rail projects. He added that these forecasts are critically dependent on the assumptions made rather than the techniques applied. He gave some examples by which the estimates can be manipulated to produce forecasts which are politically attractive or which justifies the intended projects. First is that, travel forecasts are very sensitive to the changes in land use patterns. If the future population and employment growth rates are assumed to be large, then the forecasted demand will also increase proportionately. Then, changes in the assumptions regarding parking availability, parking fees, speed along roads, and vehicle operating costs can also affect the mode choice for individuals. Increases in operating costs and travel time added with lower speeds on roads will divert commuters to using rail. Parameters are continually manipulated until the desired values for the justification of the preferred project is obtained. The author stated that forecasts used in the American rail transit systems are statements of advocacy rather than unbiased estimates produced by politically-neutral planners or forecasters. Lastly, he addressed the need for forecasts with more objectivity rather than advocacy, more transparency and honesty in the field of transportation to solve such an ethical dilemma.

The paper by Short and Kopp (2005) highlighted that transportation infrastructures are vital for both the society and economy. They also stated that such infrastructures are influential since they can dictate industrial and residential locations, "*thus structuring space and determining mobility*." Impacts of these investments can be felt for decades or more. However, transportation infrastructures are, without a doubt, very costly. Planning and financing for such investments are full of controversies and thus raises consciousness both at the national and international levels. The authors claimed that that rail investments in Europe are inefficient due to declining market share and low rates of return. Costly investments such as these, hampered by declining market share, result in losses and thus risking the economic resources of stakeholders. The authors also reported that projects like these are approved due to the lapses and problems facing transportation planning. They found out that "*planning methods vary, traffic and economic forecasts on which they are based are different, appraisal techniques are not the same, consultative and legal processes differ widely, and decision-making procedures diverge*." The authors also added that "*planning and decision making are generally politicized, and are rarely transparent*." Due to these reasons, there are only few ex-post analyses made. The main reason being is that concealment and lack of transparency shrouds decision making, and some of the evaluations made are manipulated by those who have been directly involved in the decisions.

Aside from promoting transparency in planning and decision making, fostering ex-post evaluations of transportation infrastructure projects can improve the process of infrastructure planning and can also ascertain the reputation of planning agencies. Lastly, the author stated that international coordination with countries well-experienced in infrastructure planning can also alleviate some of the weaknesses and problems of planning processes purely carried out at the national level.

Professor Bent Flyvbjerg, in *Megaproject Policy and Planning: Problems, Causes, Cures*, started out by stating the problem regarding the data set he acquired for his study. He addressed that his data set is most probably biased in the sense that estimates of cost overruns and demand shortfalls will be less than those of the population. He gave the following reasons why this can be the case:

- *"Projects that are managed well with respect to data availability may also be managed well in other aspects, resulting in better than average performance for such projects.*
- *The very existence of data that make the evaluation of performance possible may contribute to improved performance when such data are used by project management to monitor projects.*
- *Managers of projects with a particularly bad track record regarding cost overruns and/or traffic shortfalls have an interest in not making data available, which will then result in under representation of such projects in the sample.*
- *Even where managers have made cost and traffic data available, they may have chosen to present their projects in as favorable a light as possible."*

Next, he tackled the predicaments in megaprojects policy and planning. Flyvbjerg characterized megaprojects as "*inherently risky*" due to very long planning stages in which decision makers and planners often have conflicting interests. He added that unplanned or unexpected events often result in larger costs. Misinformation of costs and benefits also worsens the track record of such projects. All of these reasons, which the author stated, cause cost overruns and benefit shortfalls in majority of the projects. Flyvbjerg stated that almost 90% of the rail projects investigated, experience cost overruns of 44.7% on the average. He added that actual passenger traffic turned out to be 51.4% lower than the expected traffic on the average. As for roads, the average cost overrun is about 20.4%, with 9.5% more demand than expected. The study also yielded that the inaccuracy exists in all of the five continents and that it is constant through time.

Since projects are getting bigger, the problems caused by cost overruns and benefit shortfalls also get bigger. Cost overruns and benefit shortfalls lead to "*wastage of resources, delays and further cost overruns and benefit shortfalls, and destabilization of policy, planning, implementation, and operations of projects*." Flyvbjerg gave three possible explanations for cost overruns and benefit shortfalls. They were technical, psychological, and political-economic explanations. The technical explanation refers to the "*use of unreliable or outdated data, use of inappropriate forecasting models, honest mistakes, and lack of experience on the part of forecasters*." As for the psychological explanation, planners and project proponents or promoters often make decisions based on "*delusional optimism*" instead of carefully analyzing each possible scenario; thus overestimating demand and underestimating the costs. The last explanation, which is the political-economic explanation, states that planners and project promoters deliberately and strategically overestimate benefits and underestimate costs in order to achieve desirable results. Based on the data, Flyvbjerg rejected the first explanation since he believed that there should have been improvements in the accuracy of forecasts through time due to advances in science. He argued that for this reason to be valid, it has to explain why costs and risks are consistently underestimated and benefits are overestimated through time and across project types and location. Flyvbjerg also rejected the second explanation as the primary cause of cost underestimation and benefit overestimation. He stated that planning experts and forecasters should have corrected their mistakes resulting from optimum bias and learned from their actions after decades of practice. If optimum bias were incorporated in all the proposals, then the most worthy proposal can still be obtained. The political-economic explanation is the one favored by the author to have caused the systematic costs underestimation and benefits overestimation based on the data. He added that these estimates are intentionally slanted in order to achieve the desired results of project promoters; i.e. to get the projects funded and started. The project which looks the most appealing on proposal is the one more likely to be funded. Thus, Flyvbjerg provided the following equation to explain what is really happening:

Underestimated costs + Overestimated benefits = Project approval

The author provided some solutions in order to cure the problem of cost underestimation and benefit overestimation. He first suggested the use of better forecasting methods such as the reference class forecasting. He also suggested that strong measures of accountability, both for public and private sectors, should be employed. Less deception, more honesty, and transparency in the estimation of costs and benefits are also needed. He added that competition and market control can greatly increase the accuracy of forecasts and the performance of projects. It deals with how projects are financed and the responsibilities of all the partakers of the projects. Lastly, he asserted that institutional checks and balances should be developed and employed; i.e., the cost of providing wrong forecasts should fall on those making the forecasts.

2.2. Politics and Governance

In the paper by Giuliano (2007), the author started by arguing that three current trends have resulted in structural changes in the government. Devolution, fragmentation, and privatization have resulted in numerous benefits for society such as a collaborative and localized government, and joint public and private provision of public services. However, the author stated that these trends have led to numerous transportation decision problems such as "*preserving and enhancing the system network benefits,* *avoiding inefficient or wasteful decision, solving transportation's externality problems, and ensuring accountability*." Giuliano stated that fragmented government units often create inefficient decisions in which local conditions are prioritized instead of the overall benefits for the network. Local units advocate projects that will yield positive net benefits for their own districts without really considering the net impacts for the system as a whole. Fragmented government units also cause political tension in which each locale fight over the limited funds for each of their own proposed projects. This results in more appealing project proposals that are manipulated by the project proponents or the analysts. Thus some projects that should have been rejected were actually built. Privatization of certain infrastructures can also be justified by efficiency reasons but as more sectors are involved in the projects, the field of responsibilities and authority becomes unclear. Problems such as these can be solved by the proper allocation of risks and responsibilities among the stakeholders. Cooperation among the government units with clear roles and responsibilities along with strong leadership are also needed to reduce inefficient decisions. Lastly, major stakeholders should have more financial involvement in the projects in order to ensure the accountability for such projects.

The paper by Van den Bergh et al. (2007) deals with eight transportation innovation projects aimed towards sustainable development in the Netherlands. Though it does not focus on megaprojects, lessons learned from this paper can probably be applied to the main theme of this research. The authors of this paper stated that learning by doing is important and can be achieved through interaction with others already experienced in these types of projects. It can be accomplished by gathering documents regarding previous projects and studying them. The authors used a single framework for analysis so that results can be generalized. This also enabled them to compare distinct factors of each of the projects and identify which are helpful and which are slowing down innovations. The factors that were considered are technological, administrative and legal, political and process-related, socio-cultural and psychological, and economic factors. The authors performed two methods and both these methods concluded that political and process-related factors and the socio-cultural and psychological factors have substantial effects on the performance of an innovation.

2.3. Forecast Inaccuracies

In the papers *From Nobel Prize to Project Management: Getting Risks Right* and *Cost Overruns and Demand Shortfalls in Urban Rail and Other Infrastructure*, Professor Bent Flyvbjerg argued that living in this age of the so-called *mega projects*, people must be very particular with the proper allocation of scarce resources. Projects have increased enormously in size and therefore entail corresponding increases in costs. Investments of this size require adequate risk identification and management; by risks, we mean the uncertainty regarding costs and ridership.

The second paper by Flyvbjerg focused on the current predicaments of the mega projects in the transportation industry, mainly on rail. He stated that reduced profit margins are brought about by poor forecasting, poor risk identification, and cost escalations. Poor forecasting is not caused by the lack of methods but by the poor applications. Considering the 44 urban rail projects included in his study, which accounted for $37 billion, it can be said that the rail industry has the highest cost escalation of about 44.7% on the average as compared to bridges and roads. Also, the data shows that there is a large standard deviation among forecasts and thus results in a high level of uncertainty and risks. With regards to ridership, the same is true. Forecasted traffic is, on the average, 39.5% lower than the actual ridership. This translates to low revenues, hence a high level of uncertainty and risk in the projects. For these reasons, Flyvbjerg claimed that the urban rail industry is doubly risky, both in terms of cost and ridership. But why is this the case when a lot of studies and planning take place before a project is started? It is because the forecasts are manipulated in order to justify the more expensive investments. So, a system for checks and balances is needed. Independent studies are also required in order to validate the results of other forecasts. But how will these studies differ from the ones made earlier? The author presented an alternative method of forecasting which is derived from the theories of decision making under uncertainty. This method, *reference class forecasting*, deviates from the conventional forecasting techniques by taking the outside view of the situation. "It does not try to forecast the specific uncertain events that will affect the project but instead places the project in a statistical distribution of outcomes from the class of reference projects." This method proves to be better than the conventional forecasting techniques, which take the inside view of the situation, because it bypasses the biases and cuts directly into the outcomes. Better forecasts mean less risks and losses for society. Thus, the appropriate projects for specific circumstances can be built with more confidence.

This topic is very relevant for the South East Asian region. Developing countries need to be more cautious in consuming their vital resources. Money should not be wasted on projects that will not prove to be beneficial to the public, as is the case when deceptive data are being presented to the deciding committees. Forecasting costs and ridership is critical and thus should be given ample attention. Honest numbers should be disclosed. Not only should it be closely examined, but new methods should be employed such as the reference class forecasting technique in order to generate better estimates and thus lessen risks and losses; better use of money, and greater returns for the investments made.

Næss, Flyvbjerg, and Buhl (2006) started by stating some startling facts about the field of transportation and planning. Næss, Flyvbjerg, and Buhl observed that there were large inaccuracies in the forecasts regarding demand, costs, and risk in more than 200 large-scale transport infrastructure projects in Europe and the USA. They found out that more than 90% of all the 10 rail projects in the sample have over estimated demand. The actual numbers were less than half of what planners have predicted. As for road, the authors found out that the deviations were not as big as those found in rail and that the deviations were not one-sided, i.e., demand overestimation occurred as frequently as demand underestimation. They authors also stated some of the possible factors that cause these inaccuracies. Among them are "*poor forecasting methods, poor database, discontinuous behavior and the influence of complementary factors, unexpected changes of exogenous factors, unexpected political activities or missing realization of* *complementary policies, implicit appraisal bias of the consultant, and the appraisal bias of the project promoter*." In the last two factors where biases are incorporated, strategic misrepresentations of proposals are often done in order to achieve desirable results for project promoters. Flyvbjerg also stated that realistic forecasts are not often an efficient means to obtain project approval and financing. He also argued that forecasts in rail links projects are intentionally distorted since demand overestimation is often associated with cost underestimation.

Næss, Flyvbjerg, and Buhl tackled the issue regarding geographical bias in forecasting demand for roads exists. They hypothesized that there will be a tendency to underestimate demand in metropolitan areas, while there will be overestimation of demand in the remote parts of the country, and that less forecast inaccuracy will be observed in other areas. However, their data set do not support their hypothesis. The results of their study indicated that there are no reasons why bias can be incorporated in road projects. The possible reason they stated, is that the allocation of funds for road projects is not as competitive as the funding for rail.

2.4. International Practice

Chapulut, Mange, and Taroux (2007) investigated the performance of infrastructure projects in France. The paper first dealt with French transport law, established in 1982, which required all infrastructure projects worth over 83M € to have economic and social appraisals. Such a policy encouraged suggestions from the public. Post evaluations were also required between three and five years after the projects openings. This enabled the verification of how the projects actually performed as compared to the forecasts made when the projects were still in the planning stage. Post evaluations include matters regarding costs, traffic volume, safety, quality of service, environment, socio-economic benefits, and financial benefits. With ten out of the sixty one projects that needed post evaluations finished and ten more being completed, their study found out that high speed railway costs are underestimated while ridership is always overestimated. Motorway costs also vary from -2% and +35% from the forecasts while the traffic generated vary from -39% to +50% of the forecasts with underestimations as frequent as overestimations. The authors stated that numerous lessons were learned and the causes of inaccuracies were identified. Chapulut et al. found that increases in costs were caused by modifications to the projects, unforeseen new environmental and building rules, physical constraints, underestimation of land and building acquisition costs, while traffic and ridership are influenced by the effects of income, fuel price , railway and air transport fares. They argued that the differences can mostly be attributed to the erroneous forecasts of the base case scenario in which the project is not implemented. However, estimations of the projected effects in terms of road safety, quality of service, and the environment are close to the actual effects experienced. With the facts closely examined, they found out that more attention is now given to the studies regarding the definition of base case and project scenarios to make more credible forecasts in the future. Feedbacks from previous experiences of other countries are also found to be helpful in better identifying risks of project building.

According to Lee (2000), Benefit-Cost analysis is the leading means for evaluating projects in the USA. Thus, determining accurate values for benefits and costs are critical. Over the past three decades, debates at the US DOT shifted from 100% engineering to 80% economics. More emphasis is given on the planning, funding, costs, and benefits aspects of the projects being proposed since there are more uncertainties in this field of transportation. Travel demand forecasts are vital to any transportation project evaluation since, without estimates of users there will not be any benefits. MPO's in the USA apply the traditional four-step model. This is a bit flawed since this approach has difficulties in quantifying the effects of congestion and air quality. Base alternatives which are inefficient will be biased to those alternatives which are also inefficient and thus wasting precious funds. Despite the policies and guidance issued by the transportation agencies, the project evaluation practice in the US is still not standardized. However, there is one thing worthy of recognition with regards to the USA practice and that is, being transparent about the project conditions. Transparency in this field is very constructive since it facilitates public involvement in the projects.

Cost-Benefit Analysis (CBA) has long been used by transportation analysts in Japan according to the paper by Morisugi (2000). The author also stated that the government has recently employed CBA as the formal method for evaluating transportation projects. Economic efficiency and users' benefits are the main focus of this method. Multi-Criteria Analysis (MCA) is also incorporated to the CBA as appraisal methods for transportation projects. This analysis covers "*regional economic impacts, global and local environmental impacts, contribution to achieving minimum living standard and back-up functions for emergencies*." There are manuals for performing evaluations in Japan. Among the manuals reviewed in the paper are roads, railways, airports, and seaports, although there are other manuals available in other fields. The manuals assign specific monetary values to travel time and cost savings, supplier's benefits, terminal values at the end project life, construction cost, and maintenance and operation costs. Benefit Incidence Tables recommended by these manuals also aid in the analysis by ensuring that all investment impacts are accounted for and no double counting of impacts are made. Standard social discount rate, project life and other parameters are also included in the manual. The author stated that this policy is helpful since it will "*provide consistent and comprehensive evaluation procedures for proposed and delayed projects, and enable to compare different kinds of projects more accurately.*" However, these manuals do not suggest what type of demand forecasting techniques to use except for roads in which the traditional four-step model is used. This is actually one of the problems in the Japanese practice addressed by the author. Despite the problem concerning the unspecified demand forecasting techniques to be used, the practice of evaluating transportation projects in Japan is progressing. Their evaluation methods are already systematic and standardized and thus, closing the gap towards more efficient planning in the field of transportation.

In Nakamura (2000), the author summarized the discussions of a symposium held in Japan. The author stated that studying the past experiences of other countries is important. He also added that the experts from Europe and USA recommended the analysis of previous experiences and planning data in the field of transportation infrastructure enables the improvement of evaluation methods and its applications thus, promoting efficiency in the transportation sector.

2.5. Synthesis

South East Asian countries are fast becoming industrialized. Industrialization and progress are supplemented by these costly infrastructure projects which act 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 (Anguera, 2006; Gómez-Ibáñez, 2000; Flyvbjerg, 2003). The problems caused by these projects are very intricate and influential (Oades and Dimitriou, 2006). Therefore, much attention is needed in the planning of such risky endeavors.

The first problem that one might immediately observe in the field of transportation is that there is much politics in the planning and approval of projects (Flyvbjerg, 2003; Giuliano, 2007; O'Toole, 2006). Increase in politics entails more competition. This sort of competition, especially with regards to public funds, drives politicians to carefully manipulate their project proposals in order to outdo proposals from others. Blown up figures shown in proposals are definitely 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 these results 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 (O'Toole, 2006; Flyvbjerg, 2003) or through the personal monetary benefits, gains, or bribes obtained from each of the projects. Inefficient decisions are thus often carried out.

Any country needs to allocate scarce resources properly; therefore proper monitoring, evaluation, and international comparison or interaction are needed to identify which projects comply with the demand and cost forecasts, and other projected impacts (Chapulut, Jeannesson-Mange, and Taroux, 2007; Van den Bergh, 2007; Nakamura, 2000). However, one can effectively do all these when the methods for evaluations are standardized internationally. Doing so will enable the conclusions of the studies to be generalized, meaning that results can be compared with the others. 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.

Traffic demand forecasts are an integral part of project evaluation (Lee, 2000). It discloses the benefits of the investment to be undertaken. Project evaluations that use benefit-cost analysis are greatly affected by such estimates. Errors made or integrated in the demand forecasting phase are crucial since it determines whether the proposed project is to be pushed through or not. Project planners thus need to be more careful in utilizing assumptions of future conditions and avoid incorporating bias in the proposals.

Transparency in project proposals and decision making is the key to gain the respect and consent of stakeholders (Lee, 2000). All the details regarding planned and completed projects should be made available to the public. This way, no one is kept in the dark. Coordination between responsible agencies for the projects become easier and the issues that arise due to the projects can be resolved earlier due to the fact that all the concerned stakeholders are aware of what is happening. Practices such as those in Europe, USA and Japan should also be examined in order to learn from their experiences and current practices (Chapulut, Jeannesson-Mange, and Taroux, 2007; Lee, 2000; Morisugi, 2000; Van den Bergh, 2007; Flyvbjerg 2006; O’Toole, 2006). They all have their good and bad practices so lessons should be drawn from them.

2.6. Definition of Terms

2.6.1. $Cost\ Inaccuracy = \dfrac{Actual\ Cost - Estimated\ Cost}{Estimated\ Cost}(100\%)$

where all the costs are converted to constant prices.

Source: Flyvbjerg and COWI, 2004

2.6.2. $Demand\ Inaccuracy = \dfrac{Actual\ Demand - Forecasted\ Demand}{Forecasted\ Demand}(100\%)$

where the actual demand is the demand at the first year after the opening and the forecasted demand is the demand at the time of decision to build the project.

Source: Flyvbjerg, 2005

2.6.3. *Optimum Bias Uplift* is the necessary increase in budget to be (100-x)% certain that cost underestimation will not happen.

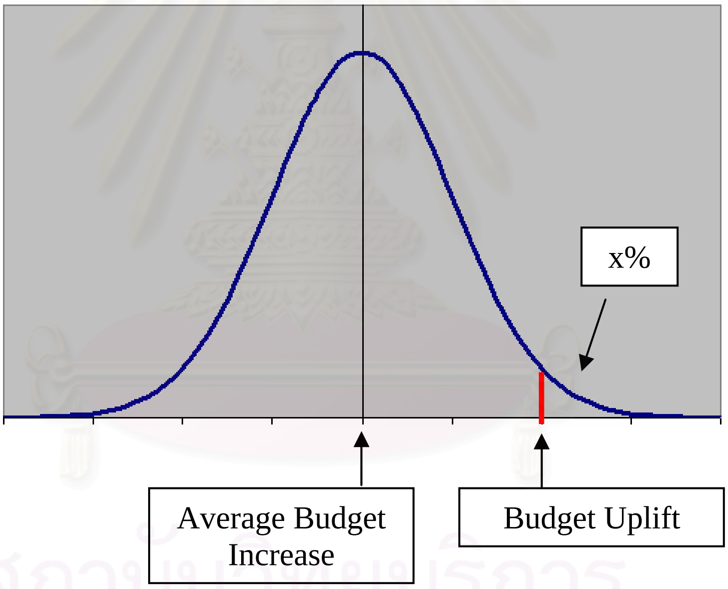


FIGURE 1. *Optimum Bias Uplift*

Source: Flyvbjerg and COWI, 2004

2.6.4. *Nominal Price* is the absolute price of a good which is unadjusted for inflation.

Source: Pindyck and Rubinfeld, 2005

2.6.5. *Real Price* is the price of a good relative to an aggregate measure of prices or it is the price of a good adjusted for inflation.

Source: Pindyck and Rubinfeld, 2005

2.6.6. *Consumer Price Index (CPI)* is the measure of the aggregate price level. The percent change in the CPI is a measure of inflation.

Source: Pindyck and Rubinfeld, 2005

CHAPTER III
METHODOLOGY

This chapter describes in detail the flow of work employed for this study. Reference Class Forecasting and other statistical analyses are also discussed.

3.1. Research Design

The author of this research constructed a transportation infrastructure projects database for the South East Asian region which verified whether underestimation of costs and overestimation of demand of such projects exist in the region. Reference Class Forecasting (RCF) technique was also performed.

The greater part of this research replicated the study, *Megaproject Policy and Planning: Problems, Causes, Cures*. The same methodology was applied to the selected transportation infrastructure projects from the selected developing countries in the South East Asian region. The first step carried out in this research was to enumerate completed transportation infrastructure projects such as roads, expressways, bridges, and rail from selected countries in South East Asia. These projects are candidates for the data gathering phase of this study. However, these projects are subject to the availability of data required. The following figure illustrates the framework for the study.

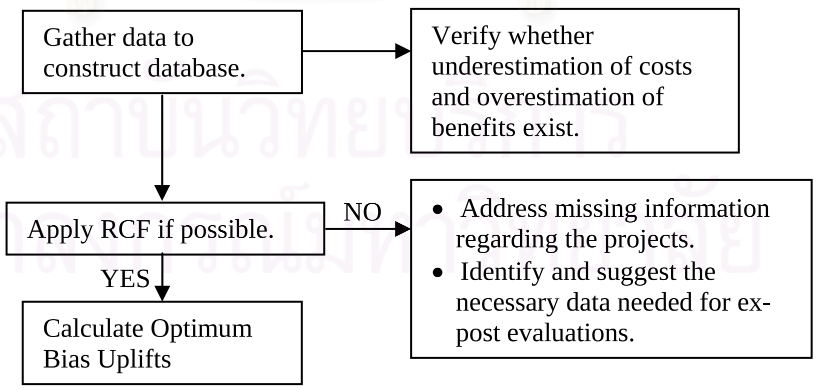


FIGURE 2. *Research Framework*

The Reference Class Forecasting Technique (Flyvbjerg and COWI, 2004)

The Reference Class Forecasting technique (RCF) takes the *outside view* of the specific project being evaluated. This method forecasts not by considering the characteristics of the particular project but rather lunges directly at the results of a similar class of previously completed projects. It averts the stages in project planning where human bias may be incorporated. The technique consists of three steps as outlined by Flyvbjerg (2006).

1. *"Identification of a relevant reference class of past projects. The class must be broad enough to be statistically meaningful but narrow enough to be truly comparable with the specific project.*
2. *Establishing a probability distribution for the selected reference class. This requires access to credible, empirical data for a sufficient number of projects within the reference class to make statistically meaningful conclusions.*
3. *Comparing the specific project with the reference class distribution, in order to establish the most likely outcome for the specific project."*

3.2. Data Considerations

Annual reports, ex-post evaluations, and materials from other similar studies are assembled in order to acquire more knowledge in the field of study. The websites of international organizations such as JICA, JBIC, ADB, World Bank, and the archives of government agencies for transportation and public works were also checked in order to obtain the necessary information on prospected projects in the region. There was also a research trip in the Philippines in order to visit the different agencies and obtain project documents to be included in the database. Statistical analyses were performed on the data from the transportation projects in South East Asia. The magnitude and frequency of demand and cost forecast inaccuracies were determined. Comparisons across project types, and location were also performed. Possible explanations were then formulated and their validity subsequently tested on the data acquired. Once the validity of the explanations has been tested, possible recommendations were then formulated. Lastly, the results from the statistical analyses of this study were compared with the results of Professor Bent Flyvbjerg in his paper, *Megaproject Policy and Planning: Problems, Causes, Cures*.

Establishing a database of transportation infrastructure projects for South East Asia proved to be difficult due to scarcity of data, time constraints, and limited resources; thus, the sample points were incorporated based on data availability. Cost and demand data were gathered for these projects. This meant that more effort is needed in order to collect a large number of transportation projects to be included in the sample. A larger sample size is needed in order to draw statistically valid conclusions from them. However, the researcher chose sample points based on data availability.

The following tables show the type of information needed in this study.

TABLE 1. *Project Details*

Details
Project Name
Project Type (road/rail/bridge/airport/port)
Type of Structure
Location/Country
Location Type (urban/rural)
Planned Opening Year
Actual Opening Year
Number of Years in Operation
Concerned Government Agency
Regulating Agency
Operating Agency
Type of Ownership
Relationship between operating agency and responsible government agency
Agency who performed feasibility study
Concessionaire
Elevated, at grade, or underground?

TABLE 2. *Cost of the Project*

Cost		Unit
Actual Cost		
Actual Cost (year calculated)		
Current or Constant Price?		
Projected Cost		
Year of Projection		
Agency who made the forecast		
In-house or Consultancy?		
Consultant who made the projection		

TABLE 3. *Delay in the Project*

Delay	
Delay in opening year?	
Cause of delay?	
Consequence of delay?	

TABLE 4. *Project Ridership*

Demand	Unit
Actual Ridership for opening year (peak)	
Actual Ridership for opening year (off-peak)	
Actual Ridership for following years (peak)	
Actual Ridership for following years (off-peak)	
Projected Peak Ridership for opening year (at project proposal stage)	
Projected Off-peak Ridership for opening year (at project proposal stage)	
Projected Peak Ridership for following years (at project proposal stage)	
Projected Off-peak Ridership for following years (at project proposal stage)	
Agency who made the forecast	
Request for Demand study report	
Assumptions made	
Models employed	
Methodology	

TABLE 5. *Units for Ridership*

Units for Ridership	
rail	pax/day
roads & bridges	veh/day

3.3. Consistency in Units

In order to facilitate the comparison of transportation projects across project types and location, the units for cost and demand must be uniform. As for the cost aspect of the transportation projects, actual and projected total costs were converted to constant prices using the same base year. However, the Consumer Price Index (CPI) matrices for the different South East Asian countries all have different base years, i.e., Thailand CPI (Year 2002 = 100) and Philippines CPI (Year 2000 = 100). Nevertheless, the matrices can still be used since the year 1995 was used as the base year for all the projects included in this research. It is stated that *"the percentage declines (or increase) in real price are the same no matter which base year you use,"* (Pindyck and Rubinfeld, 2005). This means that, all the costs of the projects are to be converted first to their respective local currencies and then convert them to real prices, with 1995 as the base year. The year 1995 is used as the base year in order to compare it with Flyvbjerg's findings. The general Consumer Price Index was used to convert the costs to real prices for uniformity since some ASEAN countries do not have the CPI by sector. In the case of demand, all the units within the sample need to match in order to be comparable. The typical units encountered in the project documents are:

- Cost in *millions of yen* with the corresponding foreign exchange rates.
- Demand for roads and bridges in *vehicles per day.*

3.4. Data Analysis

The statistical analyses were performed by using the *Statistical Package for the Social Sciences* or SPSS. Among the analysis tools included in the study are descriptive statistics, correlation analysis, and comparison of means, and other tests that proved to be useful in this study. The level of significance or the *p-value* used in this study is 0.05.

Outline of Statistical Analysis

- Descriptive statistics, i.e. mean, standard deviation, and range
- Correlation analysis
- Independent samples T-test

In comparing two populations, it is required that the group of samples be tested for any significant differences. Only differences in means and variances were tested since the purpose of comparing the group of samples is to find out whether they can be categorized together or not.

For the test between the differences in two means, the sample sizes of the two groups need to be large so that the distribution of their means can be assumed to be normal. Central limit theorem states that when both the sample sizes, n_1 and n_2, are large, then the distribution can be assumed to be normally distributed. A rule of thumb (Washington, Karlaftis, Mannering, 2003, p.38) also suggests that when n_1 and n_2 are both greater than or equal to 25, then normality can be assumed. Since the purpose of this test is to find out whether the two groups can be combined or not, the test for the difference between two means is given by the following null hypothesis, H_o, and the alternative hypothesis, H_a, respectively:

$$H_o: \mu_1 - \mu_2 = 0$$
$$H_a: \mu_1 - \mu_2 \neq 0$$

The test statistic used for the difference between two means, when the variances σ_1^2 and σ_2^2 are not assumed to be equal, is given by:

$$Z^* = \frac{\left(\overline{X_1} - \overline{X_2}\right) - \left(\mu_1 - \mu_2\right)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

where $\overline{X}$ is the sample mean, μ is the population mean, s^2 is the sample variance, and σ^2 is the population variance.

When the variances σ_1^2 and σ_2^2 are assumed to be equal, then the test statistic is given by:

$$t^* = \frac{\left(\overline{X_1} - \overline{X_2}\right) - (\mu_1 - \mu_2)}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where s_p^2, the pooled variance, is given by:

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

In testing the equality of two population variances, this study is only concerned with the following null and alternative hypotheses, respectively.

H_o: $\sigma_1^2 = \sigma_2^2$

H_a: $\sigma_1^2 \neq \sigma_2^2$

The test statistic for this test is given as follows:

$$F^*_{(n_1-1, n_2-1)} = \frac{s_1^2}{s_2^2}$$

where the larger sample variance is placed in the numerator and that the null hypothesis is rejected at the 2α level of significance when the test statistic is greater than the critical value at α.

CHAPTER IV
DATA COLLECTION

All the tasks performed in assembling the transportation projects database for this research are mentioned in this chapter. Also, the problems encountered and an overview of the results of data gathering are presented.

4.1. Data Gathering in the Philippines

The research trip in the Philippines was conducted between October 3 and 26, 2007 after two months of preparation. The first office visited by the researcher was the Department of Public Works and Highways, DPWH, on October 4, 2007. DPWH is the agency responsible for the planning, design, construction, and maintenance of national roads, bridges, water resources projects, and other public works. Engr. Crispin Banaag of the Project Benefit Monitoring Section, Development Planning Division was the contact person from this department and helped in the data gathering activities for this research. The projected and actual project costs of different road and bridge projects of the DPWH were gathered from this office. Also, the different Project Monitoring Offices of the DPWH were visited in order to acquire more transportation project documents funded by the Asian Development Bank (ADB), Japan Bank for International Cooperation (JBIC), and the World Bank (WB). The Feasibility Studies Department of the DPWH was also contacted; however, difficulties in data gathering were experienced, due to the lack of assistance and guidance in using their library. Seven days of data collection took place at this transportation agency.

The next agency contacted was the Manila Office of Japan International Cooperation Agency (JICA). Ms. Grace Ciego of the HRD section was the contact person from this agency and was very accommodating. However, due to lack of data from this agency, the researcher was referred to the Manila Office of the Japan Bank for International Cooperation (JBIC). JBIC staff provided the researcher with several ex-post evaluation documents of their transportation projects located not only in the Philippines, but in Indonesia and Thailand as well. JBIC ex-post evaluation documents contained a lot of useful information, which can be used in this study.

The main offices of Asian Development Bank and World Bank were contacted through the telephone at first in order to request for appointments. However, as the researcher informed them of the subject of the research, these two agencies only told the researcher that no data can be obtained from their agencies. The World Bank was not able to provide transportation project details due to their new disclosure policy while the ADB simply told the researcher that they do not have such a database.

Department of Transportation and Communications (DOTC) was the last public agency to be visited. DOTC is responsible for the rail, air, sea, and communications infrastructure in the Philippines. Attached to this agency are the Light Rail Transit Authority (LRTA), the Metrostar Express (MRT3), and the Toll Regulatory Board (TRB*, now attached to DPWH*). The researcher was at first hesitant in going to the DOTC because of the recent scam the agency was involved in, and that data gathering in this agency will prove to be very difficult. Allegedly, there was bribery and overpricing with the National Broadband Network deal. But since, the researcher's contact is closely associated to the Secretary of the Department, the researcher went on with the data gathering. The researcher was only able to get a referral letter from this main agency and that staffs from this agency were all saying that they do not have any documents for the projects that the researcher was looking for. The LRTA which manages LRT Line 1 and MRT Line 2 was contacted next. Only project documents from the MRT Line 2, which was opened in 2003, were completed because the staff from this agency informed the researcher that LRT Line 1, which was opened in 1984, is already very old and that they no longer keep documents of the said project. After going to LRTA, MRT 3 which is in the MRT III Depot, North Triangle Area of Quezon City, was visited. The people from this office were very helpful and that project details were easily obtained. Lastly, the TRB was the last agency where the researcher gathered data. Again, it was rather easy talking to engineers rather than ordinary staff since they were able to understand the nature of the research better, and thus were more willing to provide needed information. Documents on expressway or tollway projects were gathered from this agency.

In summary, the trip might have been more successful with better cooperation from the agencies. More project details could have been collected in order to increase the size of the transportation database to be included in the study.

4.2. Data Gathering in Thailand

Gathering data in Thailand started after the research trip in the Philippines was completed. Resources from the library of the Department of Highways (DOH) were explored. Data, such as the annual traffic counts all over the country, annual reports of the department, and feasibility studies were all available in the library. However, matching all of these documents proved to be tricky and difficult, since numerous studies were performed on a single project and tracking the most recent study made is very time consuming. With the help of Dr. Saksith Chalermpong, Ms. Wiyaporn Angkanawisalya of the Planning Bureau of the Department of Highways was contacted. Discussions with her enabled the gathering of data much easier. The previous implementation plans for recently completed transportation projects such as roads and bridges were made available. The project completion documents were also obtained from her. However, the only information readily available was all about the costs of the projects. Information regarding traffic forecasts were not accessible since she informed the researcher that not all projects have feasibility studies. Nevertheless, the information acquired will permit the application of RCF for the projects in Thailand (*cost aspect only*).

4.3. Other Sources of Data

Aside from gathering data from different government agencies, the websites of different funding institutions active in the South East Asian region were also checked. Websites of institutions such as the World Bank, ADB, JBIC, and JICA were searched and emails were sent in order to ask for permission to use and acquire cost and demand data of transportation projects in the region. Despite the efforts made, useful information was only obtained from the JBIC and JICA websites. The JBIC website provided ex-post evaluation documents of several transportation projects funded by JBIC in different South East Asian countries. Also, the JICA website gave access to the JICA library in Japan where documents of transportation projects studied by JICA are kept. Dr. Saksith Chalermpong, in his trip to Japan, visited the JICA library and gathered some feasibility studies of transportation projects in South East Asia.

4.4. Some Problems Encountered in Data Collection

1. The first problem encountered was the difficulty in getting contacts from the different transportation agencies; especially when the agency is abroad. It takes a long time to receive feedback from them. Contacts abroad also say "NO" easily.
2. There is also the problem of being "tossed" around different agency staffs. No one wants to entertain the researcher especially when they learn about the research topic.
3. Confidentiality of data is also a problem in some projects such as those funded by the World Bank and some Asian Development Bank Projects; but as for the public works projects, the agencies such as the DPWH and DOH were very cooperative.
4. With regards to the organization of the database or library of the different agencies, the researcher had a hard time looking into their records. This is the case in the feasibility studies department wherein old feasibility studies are kept. However, when the researcher gets more information on the projects, the researcher found out that there were more recent studies made on the project and that the feasibility studies do not match the actual projects implemented. The data gathering for these projects were abandoned.
5. In Thailand, some of the feasibility studies and other reports are in the local language that is why it is difficult to gather more data.

6. In the Philippines, some staffs in some agencies are very unaccommodating in the sense that they are reluctant to give any form of assistance.
7. It is also hard to believe, but most of the projects that have been gathered in the Philippines do not have traffic forecasts. The reason the researcher got was that, comparisons were only done on a before and after project basis. Comparisons of the actual and forecasted traffic figures are not performed.
8. There were also vital information of transportation projects from the DPWH that the researcher was not able to obtain because some staffs argued that the information is classified and that it contractors got hold of those information, they will most probably win most of the bids.

4.5. Results of Data Gathering

After months of data gathering, a total of 135 road and bridge projects complete with projected and actual cost data were compiled. There were six projects from Indonesia, 44 from Thailand, and 85 from the Philippines. Of the 135 transportation projects, 94 were roads while 41 were bridges.

Though it may seem that there are a lot of transportation projects included in the database of this study, there could have been more. Many transportation projects were dropped because the plans and completion documents did not match. Also, more projects could have been added to the database had the different transportation agencies and funding institutions cooperated with the researcher. Despite these shortcomings, the number of transportation projects in the database still permits the application of RCF.

CHAPTER V

TRANSPORTATION PLANNING PROCESS IN THAILAND AND THE PHILIPPINES

The chapter deals with the transportation planning practices in Thailand and the Philippines. Several feasibility studies of transportation projects in South East Asia are also reviewed in order to illustrate the actual planning practice in the region.

5.1. Transportation Planning Process in the Philippines

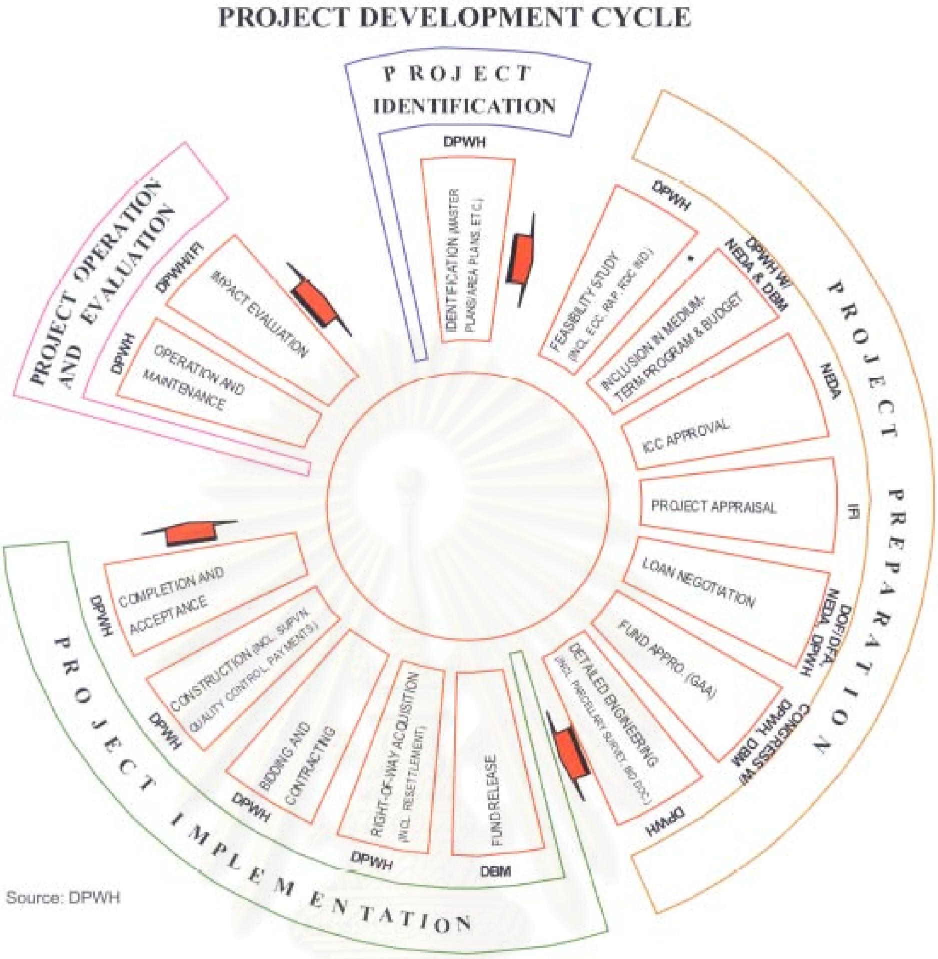
The DPWH projects, such as roads, bridges, flood control, and water supply, undergo a cyclic process consisting of four phases. These phases are project identification, project preparation, project implementation, and project operations and evaluation (DPWH, 2007).

The first phase of this cycle involves the Medium Term Development Plan of the Philippines, and regional development plans wherein projects are identified.

The next phase is the project preparation phase during which the projects are planned. This phase starts with a feasibility study on the identified project from the different development plans. In feasibility studies, the impacts in terms of economic, social, environmental, financial, and operational aspects of the projects are examined. Note that traffic forecasts for Philippine roads are usually not included in the feasibility studies of the projects. Items included in feasibility studies are the engineering design and estimates, EIRR or the economic internal rate of return, EIA or the environmental impact assessment with the appropriate environmental compliance certificate (ECC), and a resettlement action plan (RAP) whenever necessary. If the project has been found to be viable and among the top ranked contending projects that meet DPWH and National Economic Development Authority (NEDA) criteria and budget, then the project is included in the DPWH medium term infrastructure program and budget. This program is then incorporated in the Philippine Medium Term Public Investment Program of NEDA. The project must also fit in the budget of the concerned International Financing Institution (IFI) such as JBIC, World Bank, and ADB. After the feasibility study stage, the project proposal is then submitted to the NEDA Investments Coordination Committee which consists of heads and secretaries from different government departments. This is the stage where projects are evaluated and approved. If the project secures the ICC approval, then the project is ready for the appraisal of the concerned IFI where the project will get funds. The concerned IFI reviews the feasibility study and other reports to confirm the viability of the project. The cost, financing, schedule, are implementation arrangements are then arranged by the concerned IFI. The result of this arrangement between the concerned IFI and the DPWH will serve as the draft for loan negotiations. In the loan negotiations stage of the project preparation phase, discussions about the project scope, cost, financing, schedule of implementation, arrangements for implementation such as the right of way acquisition and relocation of persons affected by the project, bidding and contracting procedures for detailed engineering and construction supervision, project management, terms of financing and repayment, and loan disbursement procedures continue until an agreement has been reached. This is the time the loan for the project gets approved by the IFI. After this, the project is then included in the proposed annual budget of the DPWH where the Congress allocates the funds under the General Appropriations Act for the following budget year. The last stage of project preparation phase is the detailed engineering stage wherein technical surveys and investigations are performed. This stage includes the preparation of the bid documents, plans, specifications, instruction to bidders, draft contract terms and conditions, bill of quantities, cost estimates and price analyses. Consultants are usually hired in this stage to oversee the work.

The third phase is the project implementation phase. It includes the release of funds, right of way acquisition, bidding and contracting, construction, and completion and acceptance. Last is the project operation and evaluation phase where the project undergoes operation and maintenance and post project appraisal or impact evaluation.

Figure 3 summarizes the project development cycle undergone by each public work project, including transportation projects, in the Philippines.



Source: Roads in the Philippines, DPWH and JICA, 2003

FIGURE 3. *Project Development Cycle in the Philippines (DPWH)*

5.1.1. Transportation Agencies in the Philippines

There are two main departments of the Philippine government responsible for the planning, implementation, and maintenance of major transportation infrastructure projects. The first one is the Department of Public Works and Highways (DPWH). It is in charge of the planning, design, construction, and maintenance of roads, bridges, flood control, water resources projects, and other public works in accordance to the Medium-Term Philippine Development Plan. Attached to this agency are:

- Toll Regulatory Board (TRB)
- Road Board
- Metropolitan Waterworks and Sewerage System (MWSS)

- Local Waterworks Utilities Administration (LWUA)

On the other hand, the Department of Transportation and Communications (DOTC) is the agency responsible for the rail, air, sea, and communications infrastructure of the country. The following are the agencies attached to the DOTC:

- Land Transportation Office (LTO)
- Land Transportation Franchising and Regulatory Board (LTFRB)
- Air Transportation Office (ATO)
- Maritime Industry Authority (MARINA)
- Philippine Coast Guard
- Light Rail Transit Authority (LRT)
- Metro Rail Transit Corporation (MRT)
- Philippine National Construction Corporation (PNCC)
- Manila International Airport Authority (MIAA-NAIA)
- Mactan-Cebu International Airport Authority
- Philippine Ports Authority (PPA) National

Telecommunications Commission (NTC)

- Telecommunications Office (TelOf)
- Philippine Postal Office (PhilPost)

5.1.2. Some Transportation Issues in the Philippines

It is known that the acquisition of road right of way is difficult, even for the Philippine government, to acquire; especially in urban areas. Land owners hesitate to sell their properties, and if they do agree to sell, they do so only at exorbitant prices. There is also the issue of squatters that refuse to leave the lands, which they do not actually own, to be used as road right of way. This is due to the law which requires the owners of lands, with squatters in it, to provide relocation with complete facilities and services to these squatters in case the owners will use or sell the land. The DPWH budget is also deficient since it is quite small for the needs of the nation. And lastly, although major transportation infrastructure projects are completed and being undertaken to improve the current transportation situation, there is still the problem of integrating all these individual components in order to fully realize the benefits these projects create; though efforts are now being made.

5.2. Planning Process in Thailand

Discussions with DOH staff are the main source of the following statements.

The Department of Highways in Thailand has a planning bureau which consists of the following groups.

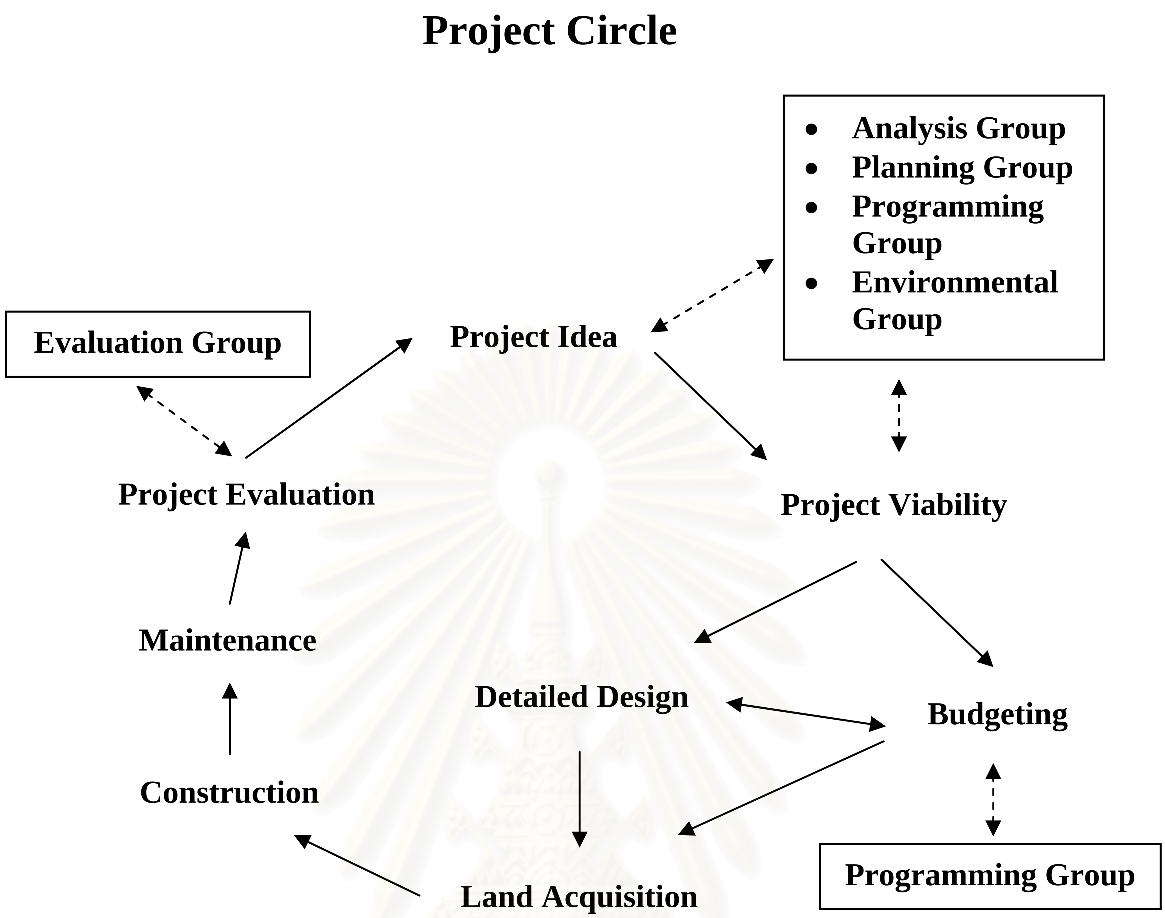
- Analysis Group
- Planning Group
- Programming Group
- Environmental Group
- Evaluation Group

Transportation projects are first identified from the different plans drawn by national and regional planners. After the project has been identified, projects such as those that need EIA's (Environmental Impact Assessment), motorways, and those that need to secure foreign funding undergo the feasibility study stage of the planning process. The feasibility studies examine the economic, environmental, financial, social, and operational aspects of the projects. The usual method applied is the Benefit-Cost analysis wherein the gains from the project are evaluated against the costs that will be incurred by implementing it. Complete passenger and sometimes, freight forecasts along with cost estimates are also included in this study. After passing the feasibility study stage, the project is included in the department's medium term plan from which the project gets re-evaluated again. The project will also undergo the phase where detailed engineering plans, costs, implementation plans, and financing plans are drawn. The project is either approved or rejected after this stage. If it gets approved then the department will schedule its implementation and appropriate funds for it, be it from the national government fund or from international institutions. Lastly, the project is set for the bidding stage and implementation.

Aside from the medium term plan of the department, mentioned above, DOH also has its annual plan which includes the following items.

1. Road Improvement in the Community Area
2. Road Paving
3. Rehabilitation of Bridge and Tunnel
4. Road Improvement for Tourism Development

Transportation projects of the DOH undergo a cycle as illustrated by the following figure. It all starts with the conceptualization of a project followed by the project viability stage wherein the project undergoes investigations regarding its costs and benefits. If the project meets the established criteria, then it undergoes the detailed design and budgeting phases; after which, the land acquisition, construction, maintenance, and project evaluation follows.



Source: Department of Highways, Thailand

FIGURE 4. *Project Circle in Thailand (DOH)*

The following are some criteria considered by the Department of Highways in Highways Planning.

- Shall be in accordance with the National Economic and Development Plan
- Shall support Social and Economic Development
- Economically viable
- Shall be implemented as set priority
- Clear objectives
- Flexibility
- Environmentally sound

There are also several selection criteria for different purposes established by DOH by which the transportation projects have to meet. Among them are the following:

Selection Criteria for Road Improvement in the Community Area

- Community size
- Traffic volume
- Problem
- Compliance with other projects
- Important location along the roadside

Estimate Construction Cost: 16 million Baht/km

Selection Criteria for Road Paving

- Existing condition
- Traffic volume
- Road network
- Population density
- Important location along the roadside

Estimate Construction Cost: 3.75 million Baht/km

Selection Criteria for Rehabilitation of Box Culvert

- Structural condition
- Width
- Compatibility with the others
- Traffic volume
- Road network & important location along the roadside

Estimate Construction Cost (Bridge): 80,000 Baht/m

Estimate Construction Cost (Box Culvert): 9,000 Baht/sq.m.

Selection Criteria for Road Improvement for Tourism Development

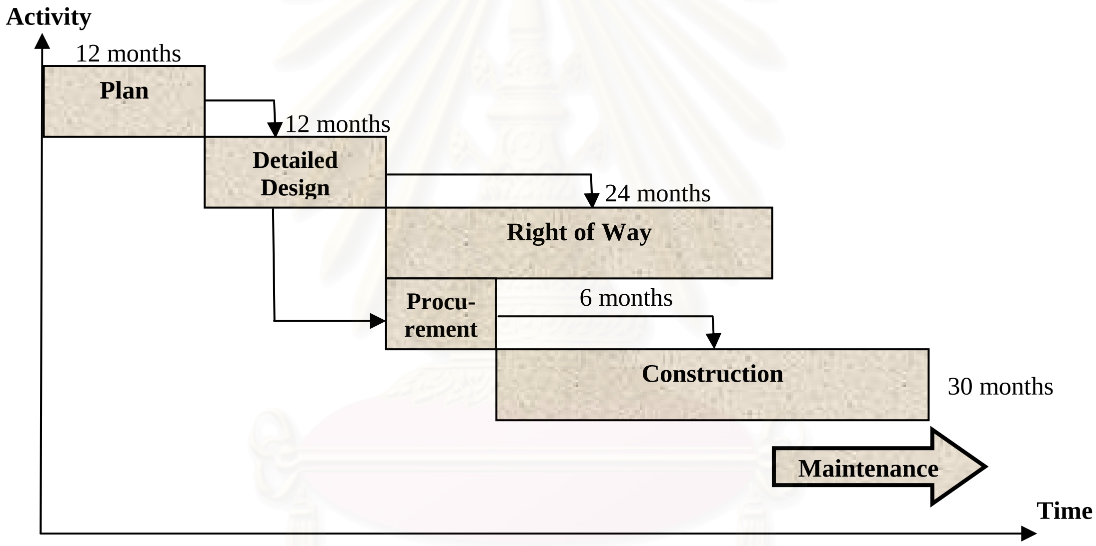
- Access to the tourist attraction area
- Tourism enhancement network

- Compatibility with other tourism enhancement route
- Famousness
- Number of tourists
- Traffic volume

Estimate Construction Cost: 8 million Baht/km

There is also a prescribed plan for the construction of highways by the DOH. Figure 5 illustrates the steps by which highway construction in Thailand ensue.

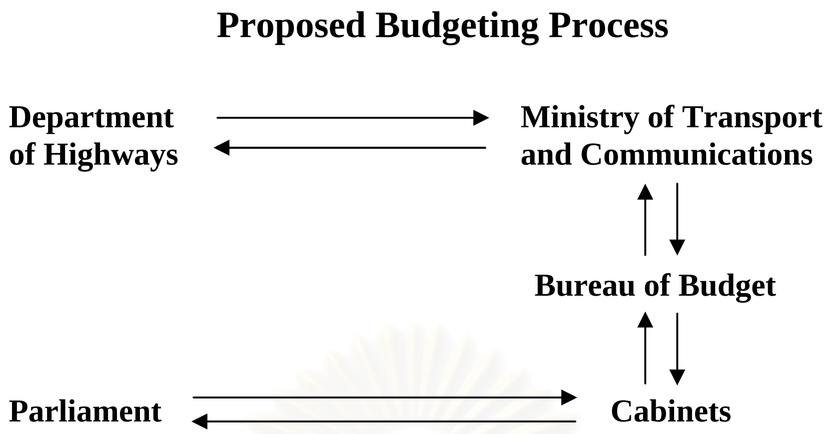
Step for Highway Construction



Source: Department of Highways, Thailand

FIGURE 5. *Steps for Highway Construction in Thailand (DOH)*

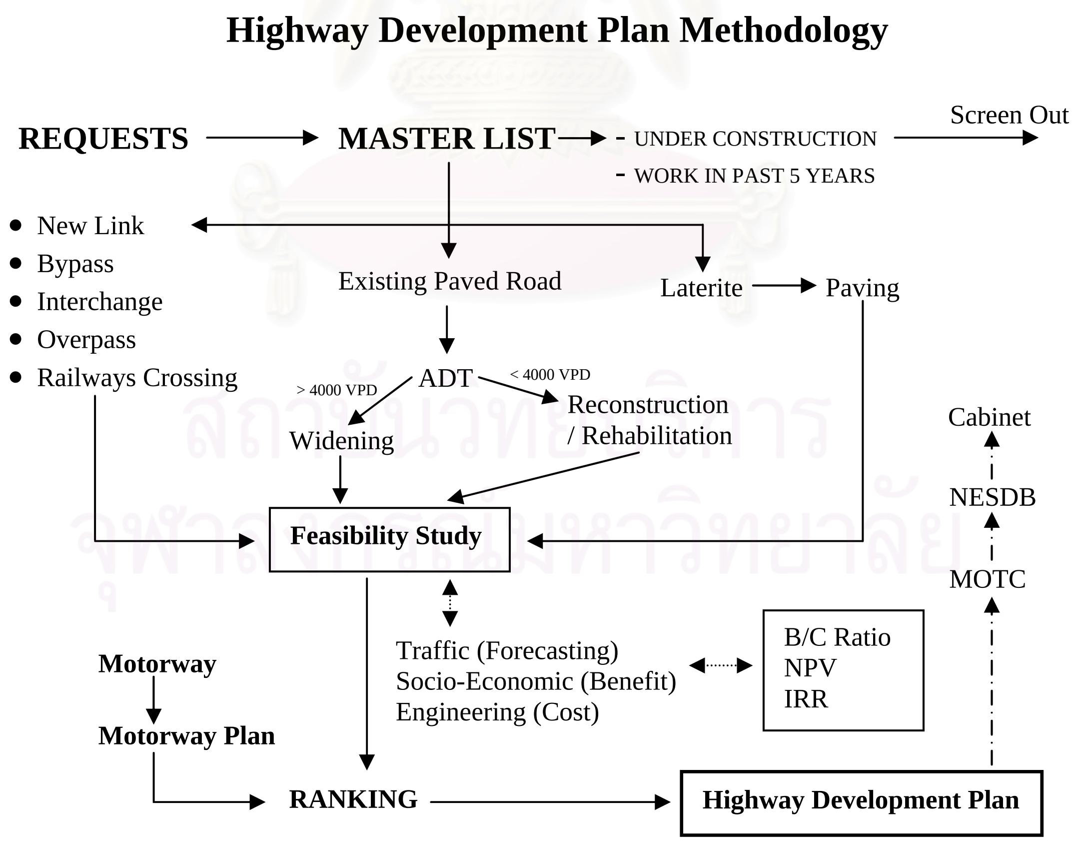
The following figure shows how the budget for transportation projects in Thailand are worked out. It can be seen that the process involves five main offices and that the course of action is linear.



Source: Department of Highways, Thailand

FIGURE 6. *Budgeting Process for Transportation Projects in Thailand (DOH)*

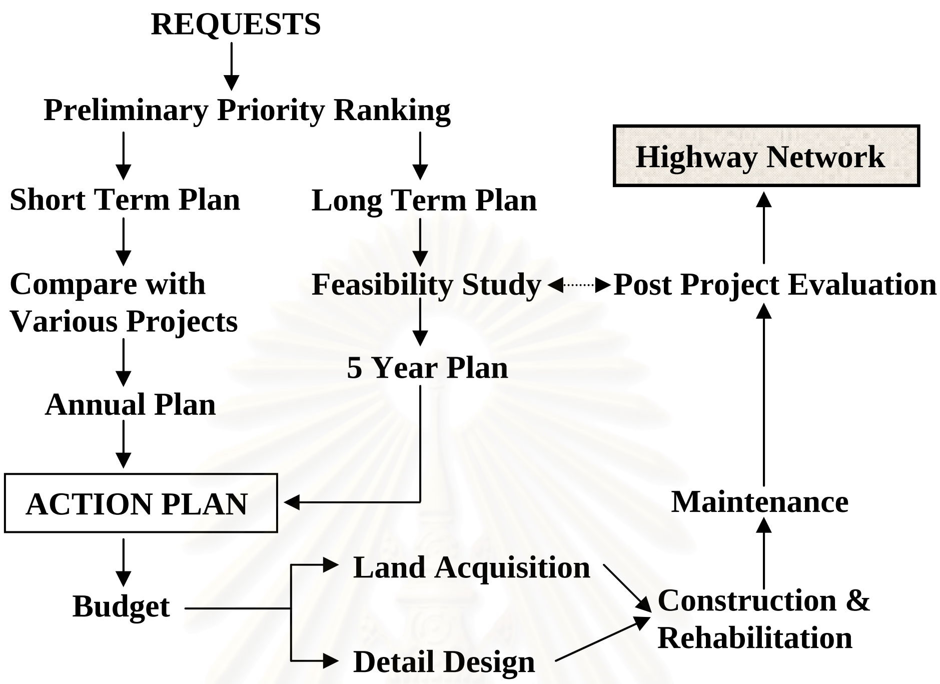
There are also different planning methodologies depending on the type of project being proposed. The following flowcharts illustrate the planning process for each of the project type being planned and studied.



Source: Department of Highways, Thailand

FIGURE 7. *Highway Development Plan Methodology in Thailand (DOH)*

Process of Highway Planning

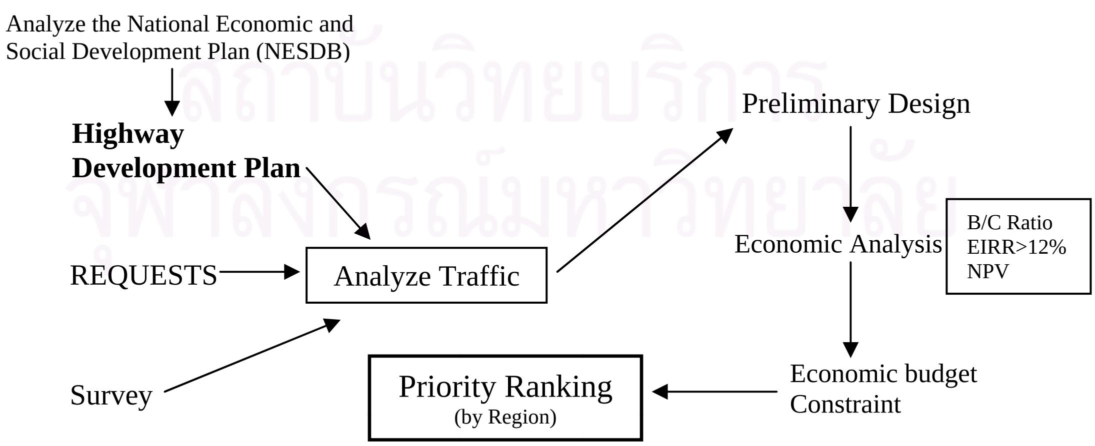


Source: Department of Highways, Thailand

FIGURE 8. *Highway Planning Process in Thailand (DOH)*

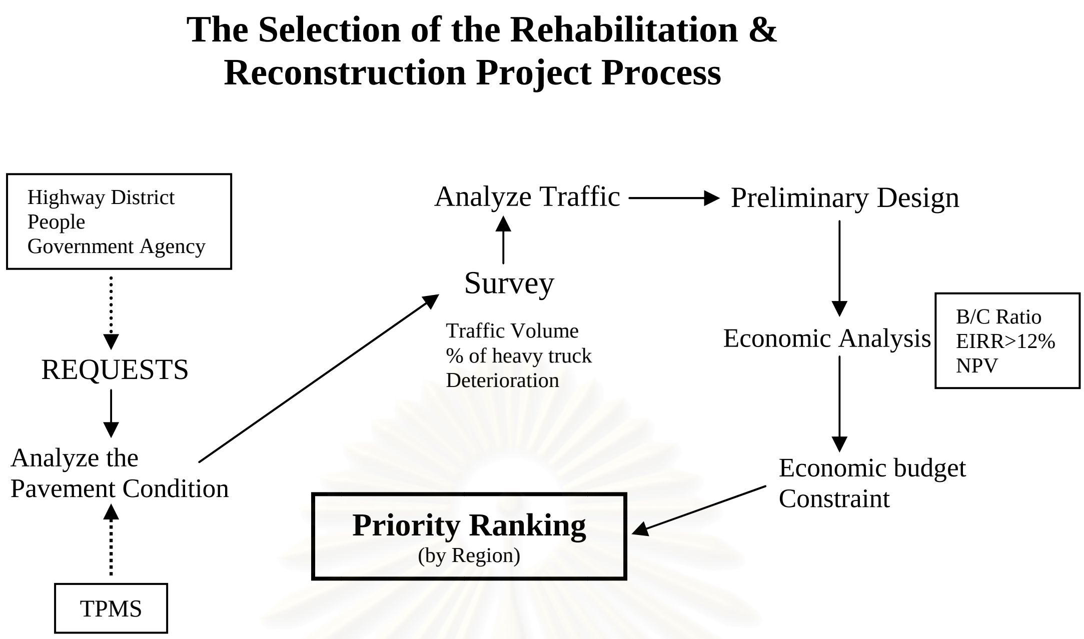
Construction Project Planning Process

(Widening, New Link, and Bypass)



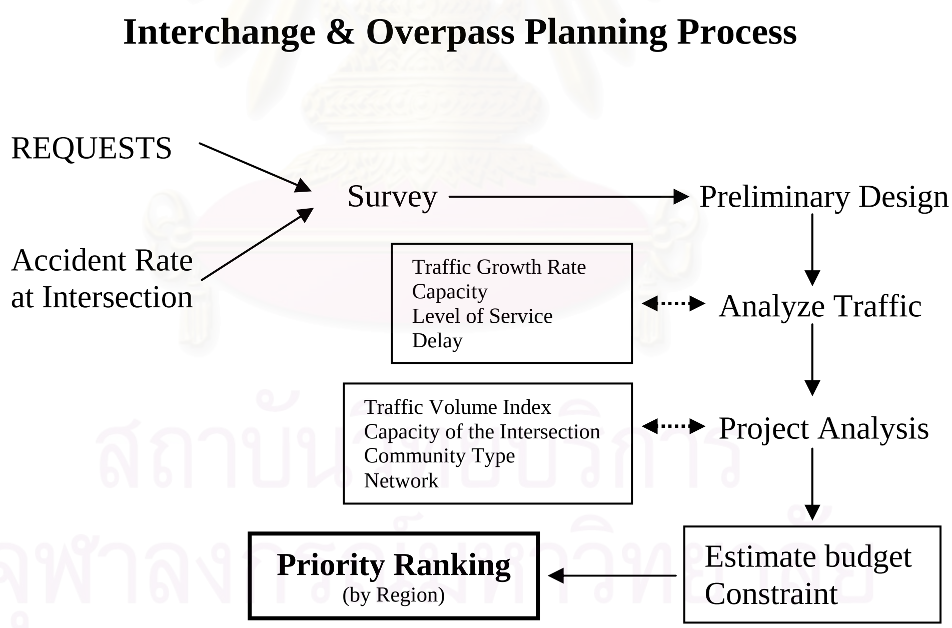
Source: Department of Highways, Thailand

FIGURE 9. *Planning Process for Widening, New Link, and Bypass in Thailand(DOH)*



Source: Department of Highways, Thailand

FIGURE 10. *Rehabilitation and Reconstruction Project Process in Thailand (DOH)*



Source: Department of Highways, Thailand

FIGURE 11. *Interchange and Overpass Planning Process in Thailand (DOH)*

5.3. Comparison of Planning Practices in Thailand and the Philippines

As discussed in the previous sections of this chapter, the transportation planning practices in both Thailand and the Philippines are somewhat similar. First, most land transportation projects are handled by agencies such as the DPWH in the Philippines and DOH in Thailand. Next is that, the transportation projects in both countries undergo similar project development cycles. Transportation projects in both countries are first identified, evaluated, implemented, operated, maintained, and re-evaluated for impacts. The bases from which projects are evaluated are also comparable. The economic, social, and environmental impacts of transportation projects are all considered in both countries. However, due to insufficient evidence, no categorical statement can be made with regards to which planning practice in the two countries is more systematic. Though, it is important to note that various criteria and processes for the different specific types of transportation projects promote efficiency in the performance and completion of the different tasks in the transportation planning sector, as mentioned in previous studies.

5.4. Some Actual Planning Practices in South East Asia

The following is a review of some feasibility studies of transportation projects in the South East Asian region investigated by JICA. The feasibility studies documents were obtained by Dr. Saksith Chalermpong from the JICA library in Japan.

5.4.1. The Mekong River Bridge Project Phase 2, Feasibility Study Update, June 1991, Maunsell - Sinclair Knight Joint Venture (Consultant)

The Australian government sponsored this project as an aid to both Lao PDR and Thailand. The bridge is planned to be 12.7m wide, with 60m central span, and should be able to support a future railway track in the middle of the road. It is planned to be constructed between Nong Khai province, Thailand and Tha Naleng in Laos. There were six design options for the main structure while there were four design options for the approach structure. There were also five different options for the type of foundation to be used. All these options were analyzed in terms of cost, social and environmental impact, O/M requirements, aesthetics, and construction risk in order to come up with the optimal design of the bridge.

The consultants performed traffic surveys in the area including manual traffic counts at five different intersections and seven other road locations. Road surveys were performed in order to determine the current flow of inter-urban traffic between areas that probably generate traffic associated with the use of the ferry facilities at that time. Interviews of passenger and vehicle ferry passengers were conducted and previous traffic data from DOH (Thailand) and SWECO (Laos) were gathered.

Passenger traffic forecast models were also generated wherein population growth, economic growth, travel cost elasticity, and reduction in non-physical barriers were considered to be the main determinants for traffic across the bridge. The first two factors were then associated with the normal traffic while the last two factors were associated with generated traffic. Two scenarios were made for the forecasts, with bridge and with out bridge. There were also three growth assumptions made; i.e. low, median, high. Forecasts were then made regarding the future freight traffic in 1995, 2005, and 2015. In mathematical terms, these are expresses as follows:

$$TN_n = T_b * (1 + POP_t)^t * \{1 + (ECON_t * E_e)\}^t$$

where:

TN is the total normal trips in year n

$\boldsymbol{T_b}$ is the total trips in base year 1990

$\boldsymbol{POP_t}$ is the annual population growth rate for period t

$\boldsymbol{ECON_t}$ is the annual growth in GDP/capital for period t

t is the period between forecast year intervals

$\boldsymbol{E_e}$ is the economic growth elasticity with a value of 1.5

$$TG_n = TN_n * \{1 + (CST_t * E_q)\}^t * E_f$$

where:

TG is the total generated trips in year n

TN is the total normal trips in year n

CST is the percent change in costs per trip "with" and "without" the proposed bridge

T is the period between forecast year intervals

$\boldsymbol{E_q}$ is the cost elasticity factor with a value of -1.5

$\boldsymbol{E_f}$ is the ratio of with and without trips due to relief of suppressed travel

From these models, financial analysis was performed. In the analysis, only the quantifiable benefits were considered and attributed to the construction of the bridge. Among these are the cost savings due to the closure of the ferry operation and associated dredging costs, the reduction in need to transfer loads between Thai and Lao trucks, the reduction in queuing time for vehicle entry, the reduction in travel time and distance for passengers and vehicles, the reduction in fees such as ferry cost and freight charges, and the increase in the number of passengers and vehicles using the bridge. The analysis showed that even if the low traffic flow was assumed, the revenue from toll collections will still be able to recover the bridge operations and maintenance costs, excluding the construction capital cost.

5.4.2. Overview of the Second Stage Expressway System in the Greater Bangkok, October 1989, Expressway & Rapid Transit Authority of Thailand

The Expressway and Rapid Authority of Thailand (ETA) is the agency responsible for the construction of the First Stage Expressway System (FES). The FES is 27.1km long consisting of three sections. In order to meet the growing demands of increasing traffic, ETA planned to construct the Second Stage Expressway System (SES). Two routes from two previous studies were considered. The first one was from NECCO (National Engineering Consultants Co., Ltd.) which proposed a 39.05km long system while JICA proposed a 27.89km long expressway. The Council of Ministers which approved this project looked for private investors to construct and operate the expressway. After evaluating two proposals, the ETA made a contract with Bangkok Expressway Company Limited (BECL) to construct and operate the SES.

Traffic forecasts, which served to aid in the design of the number of traffic lanes, on-off ramps and interchanges, and for socio-economic analysis, were prepared for the SES. Forecast traffic volumes for the opening year and years to follow were made available based on the forecasted population, land use, transport demand, and gross national product for each year.

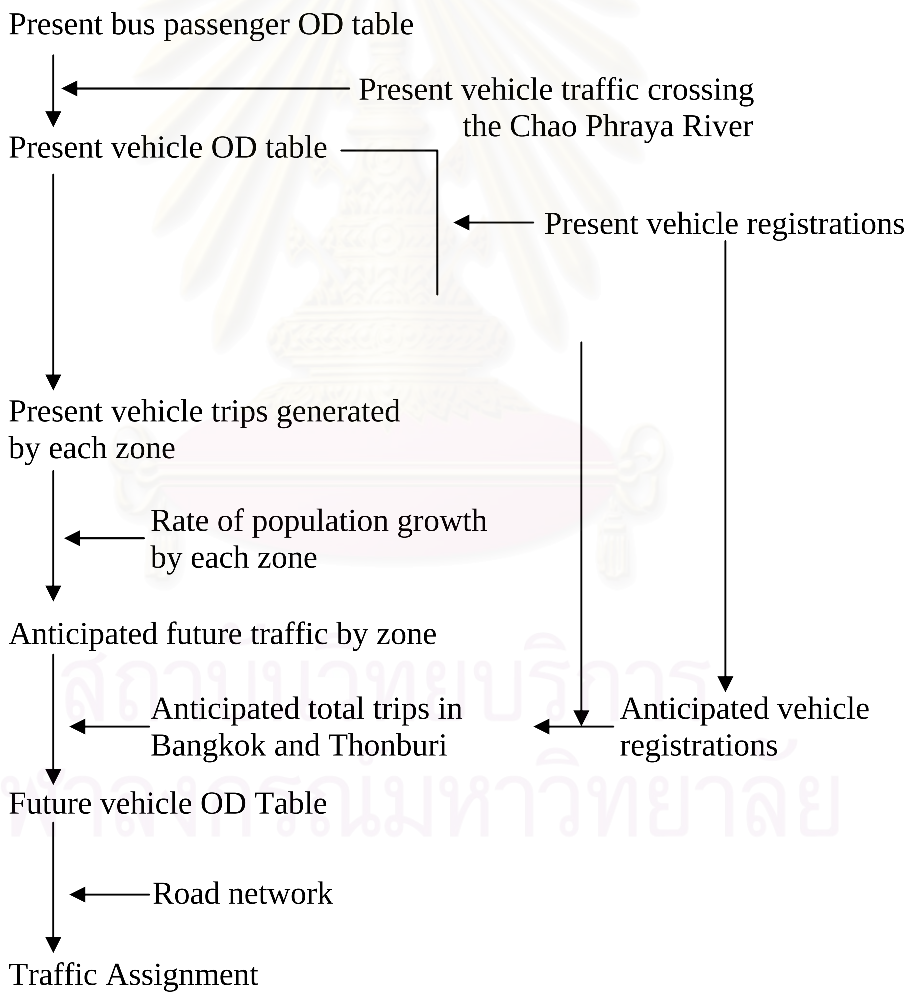
Previous studies by JICA and NECCO also estimated that the investment costs for the SES is about 16 to 18 billion Baht. However, they expected the cost to rise to more than 30 billion Baht during the actual construction. Despite these, the analyses from these two studies indicated that traffic in Bangkok will greatly be improved. Both studies also indicated that there is a high rate of economic return and the benefit-cost ratio is between 1.65 and 2.32. The SES is also expected to aid in urban development and better land utilization around the affected areas.

5.4.3. Feasibility Study Report on Bangkok-Thonburi Bridge No.1 Project, October 1968, Overseas Technical Cooperation Agency Government of Japan

The small number of bridges along the Chao Phraya River makes it difficult to cope with the worsening traffic congestion in the metropolis mainly Bangkok and Thonburi. Thus, the government formulated a 5-year bridge construction plan in order to relieve traffic in the heavily congested bridges in the city, especially the Memorial Bridge. These bridges are necessary in order to connect the two cities so they can closely function.

A traffic survey was conducted by General Engineering Company in 1967. It showed that there were about 160,000 vehicles traveling between Bangkok and Thonburi. The study also exposed the fact that the Memorial Bridge served 66% of the total vehicular traffic between Bangkok and Thonburi. Thus, there is no question about the heavy congestion over the said bridge and constructions of new bridges were highly desirable due to the fact that vehicles change routes, even if larger costs would be incurred, just to avoid traffic congestion.

The following figure summarizes the methodology employed for the traffic forecasts made for Bangkok and Thonburi.



Source: JICA

FIGURE 12. *Flow Diagram for Traffic Forecast between Bangkok and Thonburi*

It can be seen from the previous figure that everything was based solely on the person trip survey on bus passengers conducted by the Ministry of Thailand in 1965. It is rather lacking in information since the trip purpose was limited to daily commute and that the respondents were mostly government employees. However, this survey was the only survey available at that time.

After generating the model, benefits of the project were assessed. The quantifiable effects included were savings in travel costs and the reduction in travel time express in time cost. It is also important to note here that the costs considered include the original project cost and the annual operation and maintenance costs. Results of benefit-cost analysis indicate that over the 50 year lifespan of the bridge, the ratio turned out to be 1.06 and that the total invested capital can be recovered after 13.76 years. Thus, the project proved to be worth the costs invested.

5.4.4. East-West Transport Corridor Project Technical Report 11 Bridge Structure Investigations, Da Nang, November 1997, Maunsell Pty Ltd et al (Consultant)

Nguyen Van Troi Bridge was built at the end of the 1950's and serves as a means of crossing the Song Han River. It connects Da Nang to the Tien Sa Port and in 1979, it was repaired to serve as a railway bridge between the two areas. However, the bridge was damaged due to lack of maintenance of the bridge structure. Thus, in 1993, the state government, the Ministry of Transport (MOT), and the Vietnam Railway Union of Quang Nam-Da Nang repaired the bridge to meet the needs of the public. A few years later, the MOT ordered that a feasibility study be made regarding the repair and upgrade of the existing railway bridge into a road bridge which has 4 traffic lanes.

The actual methodology employed for traffic and cost forecast, and other analyses were not explicitly discussed in this study. Reasons such as reducing operation costs for vehicles moving between Da Nang and Tien Sa Port, compliance with the Master Plan and transportation development plan for the city, and serving as an economic development catalyst for the city were enough for them to conclude that the bridge repair and upgrade was required. Also, despite the increasing traffic flow in the area which was verified from a traffic survey in 1996, the project was not clearly justified since no economic and financial analyses were mentioned in this study. The same observations were also found in the feasibility study for the Tuyen Son Bridge Project except that different scenarios of future development of the area were considered.

5.4.5. Republic of Indonesia Preliminary Study Report on Central Jawa Expressway, March 1992, Ministry of Construction International Engineering Consultants Association, Tokyo, Japan

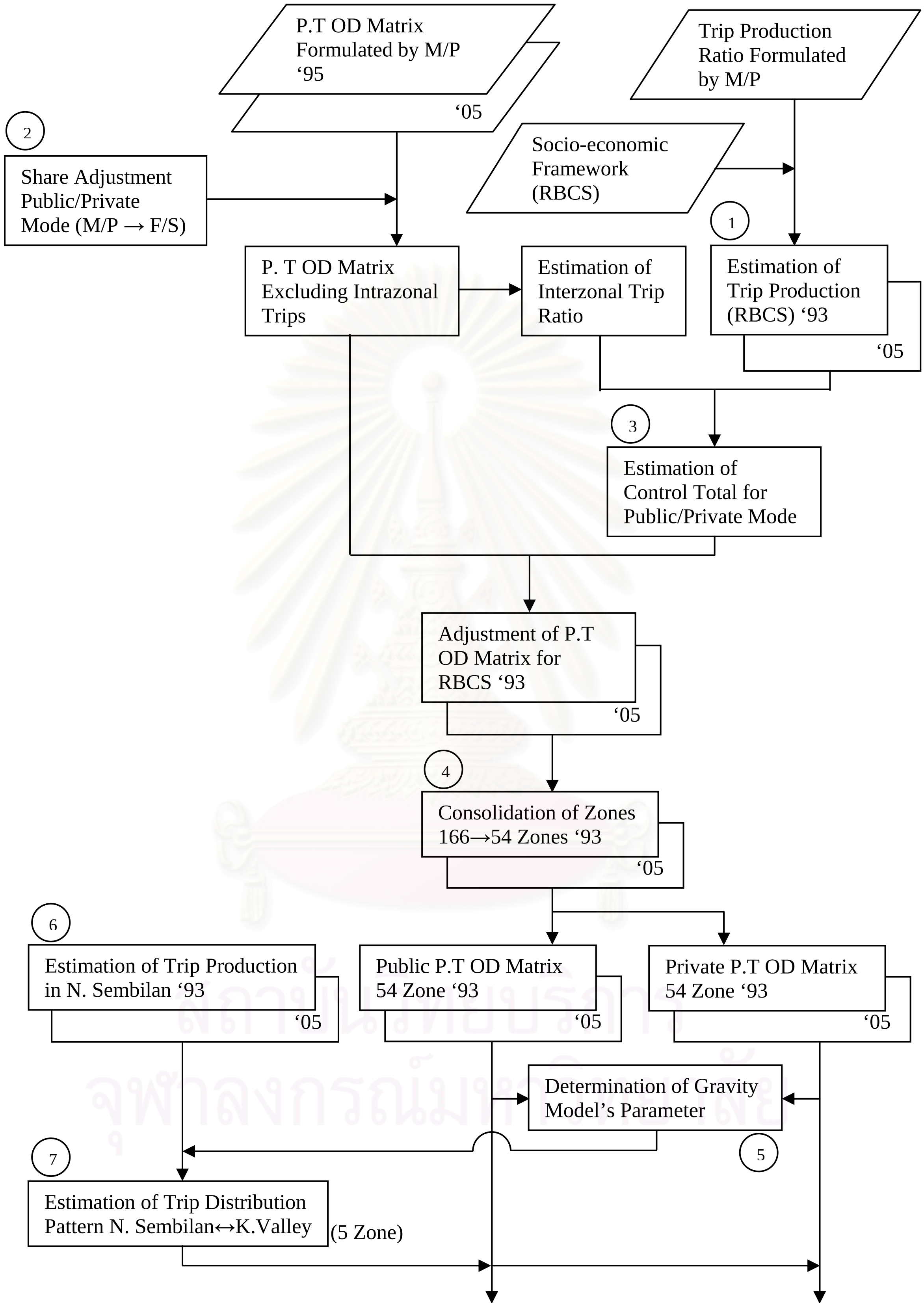
This study is a pre-feasibility study therefore the analysis made here was minimal. The main purpose of this study is to find out the importance and urgency of the Central Jawa expressway project. Several agencies were involved in this study and among them are JICA, consultants, Bina Marga, PT. Jasa Marga, and the Japanese Embassy in Indonesia. The existing traffic condition in the affected areas of Batang, Semarang, Surakarta, and Yogyakarta were studied; some 230km of expressway that will eventually be a part of the Trans Jawa highway. Among the findings of this study was that forecasted traffic from previous studies (1973 and 1987) is too low as compared to the current volume. The team of consultants also recommended some of the matters that should be tackled in the feasibility study of this project. Among the issues are the alignment, optimum access distance to existing roads, conformity with other projects, implementation plan, engineering designs, and economic and financial studies.

5.4.6. The Feasibility Study on Rail-Based Commuter Services in Klang Valley, Malaysia, Final Report, February 1991, Japan International Cooperation Agency (JICA)

This report tackles the studies made for the rail-based commuter services in Klang Valley, Malaysia in terms of its technical, economic, and financial aspects. The project consists of 2 rail lines, the northern and southern lines which are 32km and 74km respectively. The study on this project was conducted in 1991 however, there were a lot of assumptions made regarding the future conditions of the rail network and as such is prone to risks. Among these are the double tracking of the project by 1993 along with the construction of new stations and halts, upgrading of telecommunications and signal system, the integration of the rail network by 2005, and other improvements in the facilities of the project; which by the way are from other proposed projects. These assumptions are the foundations by which the forecasts are based and thus are critical factors to the success of such forecasts. Other factors considered for the forecasts are population and employment distribution in the affected areas along with the corresponding growth rates. For the ridership forecasts, planned feeder buses and other proposed improvements from other projects are also introduced in the analysis.

Demand forecasting for this project is similar to the previous study performed by JICA for this project. It started from the estimation of trip production according to car ownership, employment status, and trip purpose along with the application of the latest population and employment data. Next, the vehicle composition was updated, i.e. the public and private modes. The new inter-zonal trip ratio according to mode is then calculated. Some traffic zones are then merged to reduce the number of zones from a previous study of JICA; thus a new O/D matrix is generated. After this, the parameters for the gravity models of the private and public modes were calculated in order to proceed with the trip distribution phase of the 4-step model. The O/D matrix for railway and bus is then generated and the modal split between rail and bus were estimated based on a theoretical diversion curve from the previous study of JICA; wherein travel time is the factor considered for diversion. Finally, trips were assigned to the respective railway links according to the O/D matrix. Basically, the original 4-step model from the previous study of JICA was duplicated except that adjustments were made in the models and parameters in order to account for the traffic and economic conditions at that time. Both the government and private sectors worked in the demand forecast for this project.

New policies and projects regarding the effects of the planned project are also tackled with the aim of having better land use development. The following figure summarizes and illustrates the methodology performed for the demand forecasts in this study.



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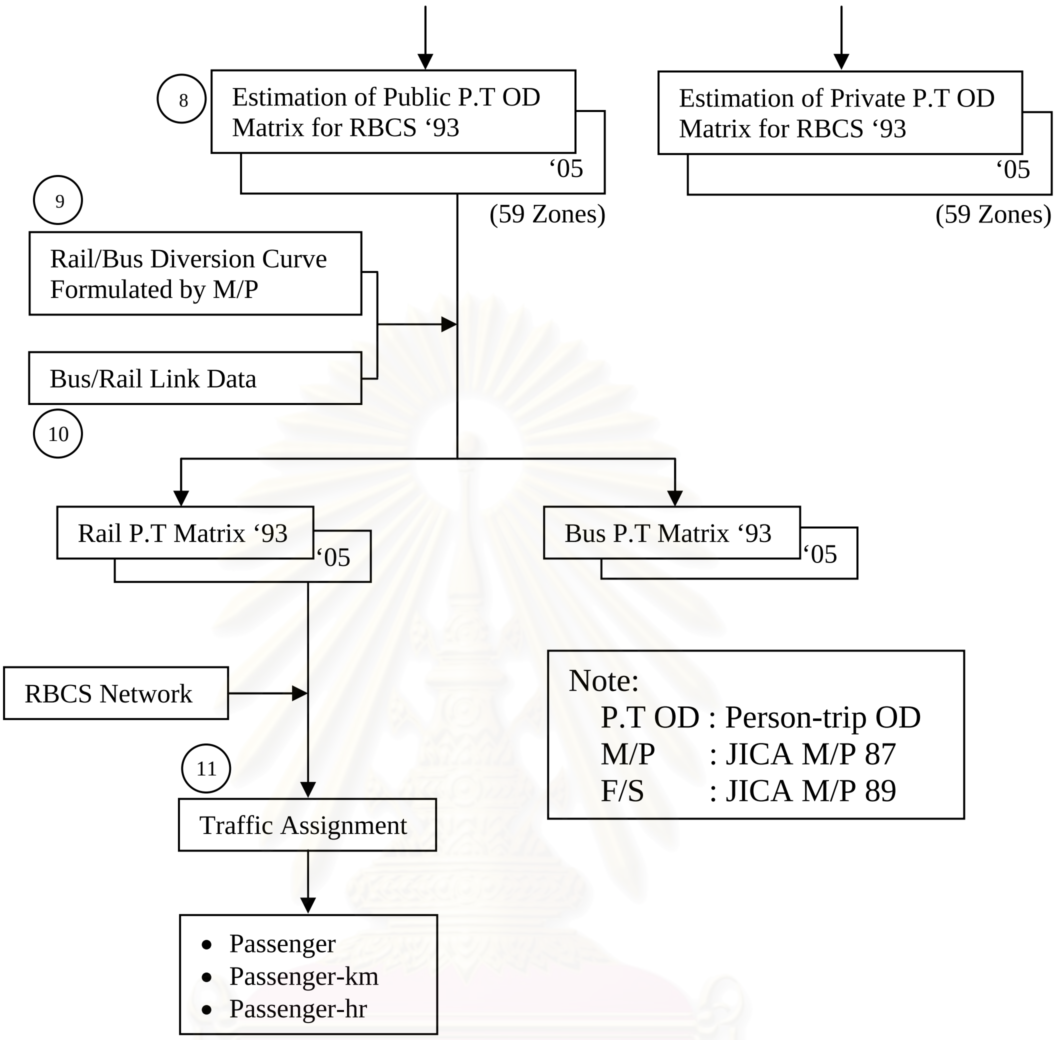


Source: JICA

FIGURE 13. *Demand Forecast Methodology for the Feasibility Study on Rail-Based Commuter Services in Klang Valley, Malaysia*

A study was also performed on the improved feeder-bus system since it was assumed to be operational upon the completion of the RBCS. Passenger interview surveys, review of the number of buses and facilities required to meet the established criteria, and studies regarding matters of operation costs and investment needed for implementation plans were performed in this study. Interview surveys were performed in order to determine the parameters of the model for mode choice and the passenger service level required to make rail more attractive than using bus or car users. The interviews showed that almost 70% of the existing users of rail live close to the stations. This means that better rail access can attract more passengers to using rail. Other interviews with bus and car users also showed that providing feeder bus service and decreasing the headway for rail will divert users to rail and thus, increase ridership. In order to achieve this, certain factors need to be investigated and among them are the passenger demand, feeder-bus routes, bus operating hours and frequency, bus operating speed, number of buses, number of buses operating at peak hours, ratio of traffic concentration at peak hours, type of bus to be used, costs, income, and benefits.

5.4.7. Synthesis

There are only seven feasibility studies of transportation projects in South East Asia reviewed in this research. It may not actually represent the population of transportation projects in the region but is still worth investigating. The review of some feasibility studies gives a rough picture of the existing transportation planning practice in the region.

Almost all of the feasibility studies of transportation projects gathered from the JICA library in Japan used the benefit-cost ratio in their analysis of the viability of the projects. However, in some projects, there were certain criteria that were included aside from the quantifiable benefits and costs such as the social and environmental impacts, aesthetics, and construction risk. There were also differences in the items included in the costs. Some projects considered the project construction costs while others did not. In terms of the models used for the traffic demand forecasts, almost all used the conventional four-step model. However, there were differences in the type of data used; i.e. there was a project without actual traffic survey and simply based the traffic forecasts on the person trip survey of bus passengers from a certain government agency. Also, there was a project which was a bit too optimistic since the forecasts were made on the assumption that certain developments have been completed when in fact, these developments were also still in the project planning phases.

The researcher has no idea whether these projects have been implemented or not. But in case they were implemented, there should also be ex-post evaluations made in order to know how the projects performed; not only for these projects but for all other major transportation projects.

CHAPTER VI
RESULTS AND DISCUSSION

The results of the analyses performed on the database of transportation projects in the selected countries in the South East Asian region are presented in the chapter. The cost inaccuracies in transportation projects are discussed in detail. Factors such as project types, location, project size, and source of funding are also included in order to determine the cause of differences in cost overruns in transportation projects. The results of this research are also compared with the results of a previous study in this chapter.

6.1. Descriptive Statistics of the Transportation Projects Database

After gathering data of transportation projects in selected countries in the ASEAN region, a total of 135 road and bridge projects were compiled. The sources of data were offices such as the ADB, JBIC, JICA, DPWH, DOTC, and the DOH. Information such as the projected and actual costs of the projects were gathered from these offices. The distribution of these projects in the different countries is shown in Figure 14. It can easily be seen that there were very few transportation projects collected from Indonesia, only six, since JBIC was the only source of data from the country and that there was no research trip to Indonesia due to lack of contacts. The case for the Philippines was a bit different as compared to Indonesia since there was a research trip conducted and that there were 85 road and bridge projects collected form the country.

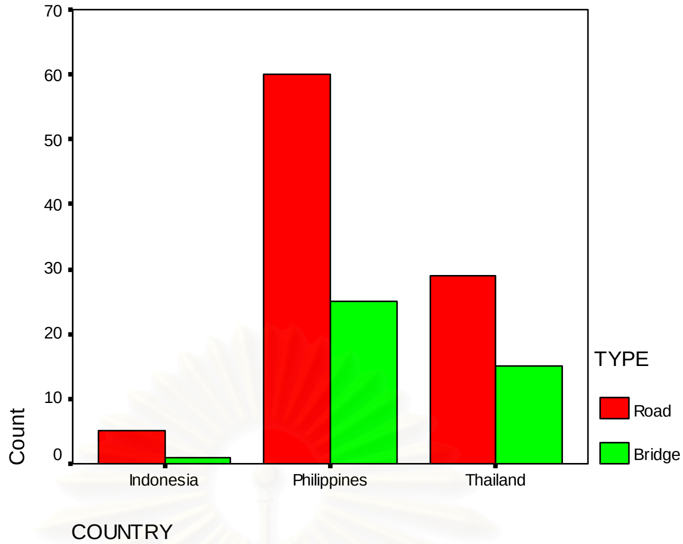


FIGURE 14. *Distribution of Road and Bridge Projects in Selected ASEAN countries*

Table 6 shows the descriptive statistics for the cost overrun in the three countries with respect to project type. It can be seen that about one third of the projects in the database are bridge projects while the remaining are road projects. Looking at the COSTOVER standard deviation values for roads and bridges, it can be said that the values are close to each other. Also, the average values of cost overrun with respect to project type are small since the mean for roads is negative while bridge projects have a small positive mean. Considering the delay in these projects, not all have information as to the planned and actual dates the projects were completed; thus, smaller *N*. Road projects seem to have more delays than bridge projects as seen in the mean and standard deviation values.

TABLE 6. *Descriptive Statistics for Transportation Project in Selected ASEAN Countries with respect to Project Type*

COSTOVER (%)				DELAY (months)			
TYPE	**N**	**Mean**	**Std. Deviation**	**TYPE**	**N**	**Mean**	**Std. Deviation**
Road	94	-1.2124	37.23755	Road	71	19.1	19.39
Bridge	41	2.2736	35.10376	Bridge	29	9.3	10.58

Table 7 shows the descriptive statistics for cost overrun and months of delay in project completion in the three countries. The Philippines is the only country with a positive cost overrun but Indonesia has the highest standard deviation while Thailand has the least amount of cost overrun and smallest standard deviation. In terms of delay, Thailand has the biggest amount of delay. However, it seems not to represent the population since Thailand and Indonesia only have nine and six transportation projects included in the database with information on delays.

TABLE 7. *Descriptive Statistics for Transportation Project in Selected ASEAN Countries with respect to Country*

COSTOVER (%)				DELAY (months)			
COUNTRY	**N**	**Mean**	**Std. Deviation**	**COUNTRY**	**N**	**Mean**	**Std. Deviation**
Philippines	85	5.4084	35.90187	Philippines	85	15.16	17.829
Thailand	44	-10.8175	30.49495	Thailand	9	24.22	11.465
Indonesia	6	-.7483	67.38081	Indonesia	6	19.83	24.277

6.2. Case of Thailand

6.2.1. Overview of Transportation Projects from Thailand

For the transportation projects in Thailand, the information regarding costs were gathered from JICA, JBIC and the Department of Highways (DOH). Traffic data were also explored however, only actual traffic volumes were available therefore comparisons between planned and actual values can not be performed. There are a total of 44 transportation projects gathered from Thailand, 15 of which are bridges while 29 are road projects as seen in the following figure.

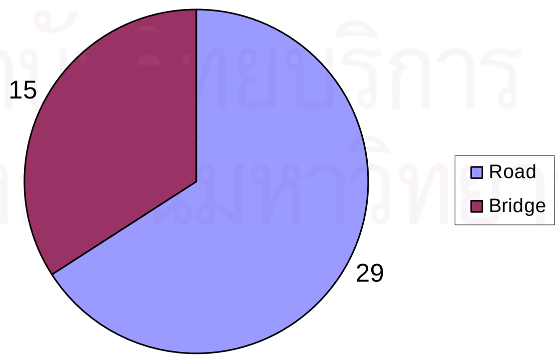


FIGURE 15. *Pie Chart of Transportation Projects in Thailand*

6.2.2. Classification of Cost Overrun in Thailand

Since there is a considerable number of transportation projects gathered from Thailand, it is important to find out whether the groups of projects should be joined into one big class or not. Flyvbjerg and COWI (2004) suggested that if there are at least 10 projects in each of the two groups, then they should be tested whether they can be considered equal or not. Thus, the group statistics, shown in Table 8, are first calculated in order to proceed with the independent samples T test shown in Table 9. This test is performed in order to identify the relevant reference class of transportation projects. The test for difference in sample variances is performed first since the test for the difference in sample means requires the assumption regarding the equality in variances. The null hypothesis for this test states that the two sample variances are equal while the alternative hypothesis states just the opposite. It can be verified from Table 9 that the F value is very small and definitely less than the critical value which is also confirmed by the significance value of 0.690 which is greater than the 0.05 level of significance. Thus, it can be said that there is no statistical difference between the sample variances. Also, by looking at the columns for the test for equality of means associated with the assumption of equal variances, it can be verified that the 2-tailed significance value is far too big to satisfy a 95% level of confidence. Thus, from the results of the analysis using the SPSS software, there is no reason for the two sample groups to be considered individually. Thus, the reference class of projects for Thailand includes both road and bridge projects.

TABLE 8. *Group Statistics for Transportation Projects in Thailand*

	TYPE	N	Mean	Std. Deviation	Variance
COSTOVER	Bridge	15	-11.5993	31.13009	969.082
	Road	29	-10.4132	30.70973	943.087

TABLE 9. *Independent Samples Test for Transportation Projects in Thailand*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
COSTOVER	Equal variances assumed	.161	.690	-.121	42	.904
	Equal variances not assumed			-.120	28.084	.905

Now that the 2 groups of samples can be joined together, Table 10 shows the descriptive statistics for all of the transportation projects considered in Thailand. A negative value for the average cost overrun indicates that, in real terms, the actual cost is less than the projected cost in real terms. This is actually good since most of the projects are completed within the budget. Even if one looks at the cost overrun, in nominal terms, the average underestimation is only 0.6193, which is not even 1% of the projected cost. However, there is one thing which does not look so good in this table. The average delay for projects in Thailand is almost two years or 24 months; but the costs are well managed in such a way that they do not go over the budget.

TABLE 10. *Descriptive Statistics for Transportation Projects in Thailand*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
DELAY	9	6.00	38.00	24.2222	11.46492	131.444
COSTOVER	44	-58.83	106.64	-10.8175	30.49495	929.942
OVER_NOM	44	-53.93	120.89	.6193	32.90510	1082.745

The correlation matrix is shown in Table 11. It can be seen that both the number of months of delay and cost overrun in real terms are significantly and positively correlated with the year of forecast of the transportation projects. This means that as the years go by, the amount of delay and cost overrun increases. However, the data gathered may not represent the true population or scenario due to the small sample size of this research.

TABLE 11. *Correlation Matrix for Transportation Projects in Thailand*

		DELAY	COSTOVER
YR_FRCST	Pearson Correlation	.686(*)	.447(**)
	Sig. (2-tailed)	.041	.002
	N	9	44

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

From the correlation matrix, it is said that as the years go by, the amount of delay experienced and cost overrun increases. This can graphically be seen in Figures 16 and 17. The trend lines show that there is a positive trend with these two variables. Figure 18 shows the histogram for COSTOVER. It can be seen that most of the sample points are less than zero. This means that the optimum bias uplift for Thailand will only be limited to a small range of acceptable levels of cost overrun as illustrated in Figure 19.

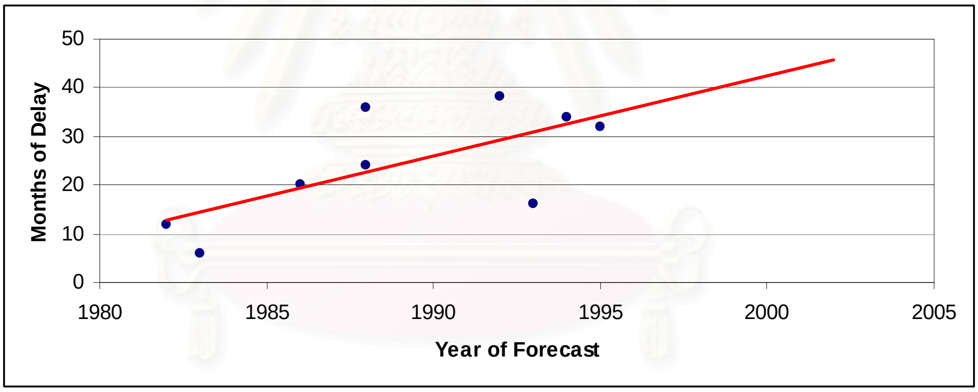


FIGURE 16. *Scatterplot of DELAY vs. YR_FRCST w/ trendline for Transportation Projects in Thailand*

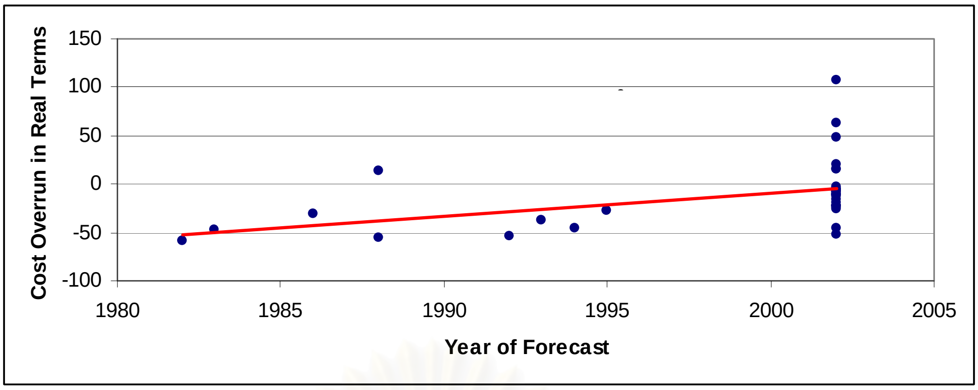


FIGURE 17. *Scatterplot of COSTOVER vs. YR_FRCST w/ trend line for Transportation Projects in Thailand*

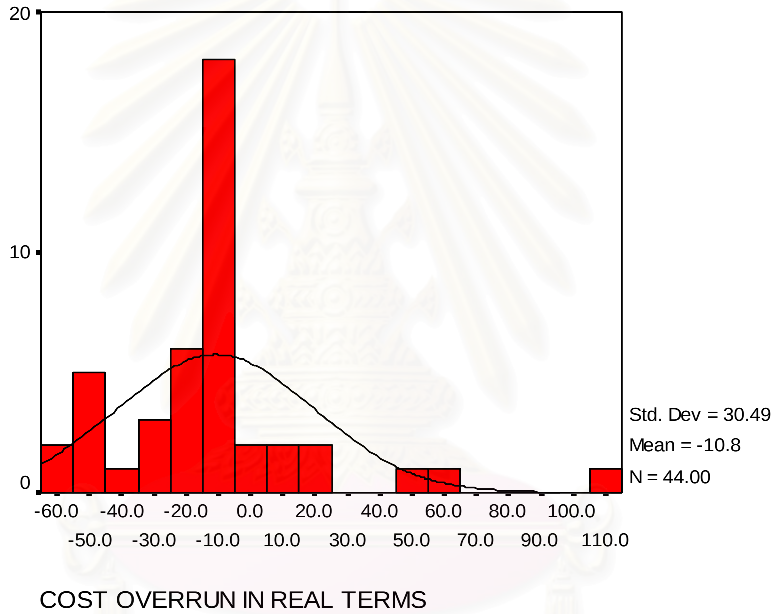


FIGURE 18. *Histogram of Cost Overrun in Real Terms for Transportation Projects in Thailand*

The following figure shows the required bias uplifts for a certain acceptable chance that cost overrun might happen. It is clear that the chances of cost underestimation included in the graph are limited. The largest chance of cost underestimation happening, with a positive bias uplift is at about 13% with a required uplift of almost 13%; a 5% chance that cost overrun may happen, needs about 49% of uplift in its budget. Again, the limited levels in the figure is caused by the fact that a lot of projects included in the database experienced small or even no cost overrun. This may actually change if there were more sample points included in the database. The true scenario can be shown more clearly and accurately if there are more projects in the database.

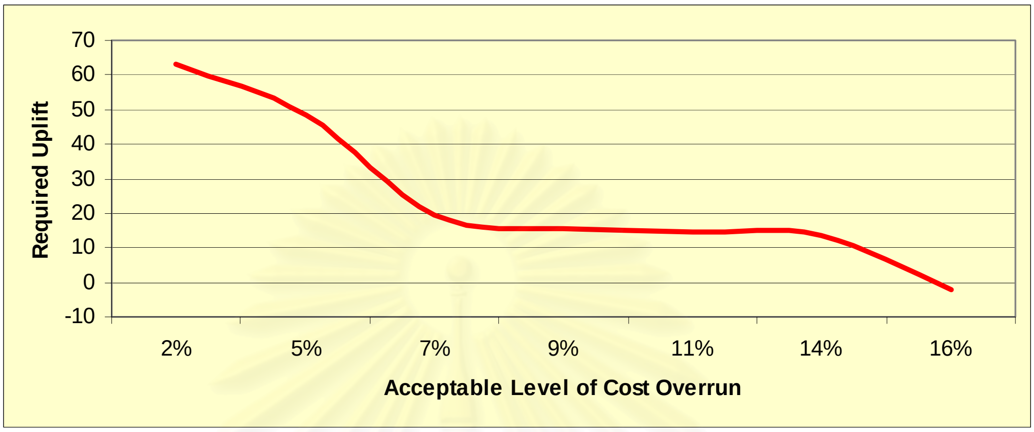
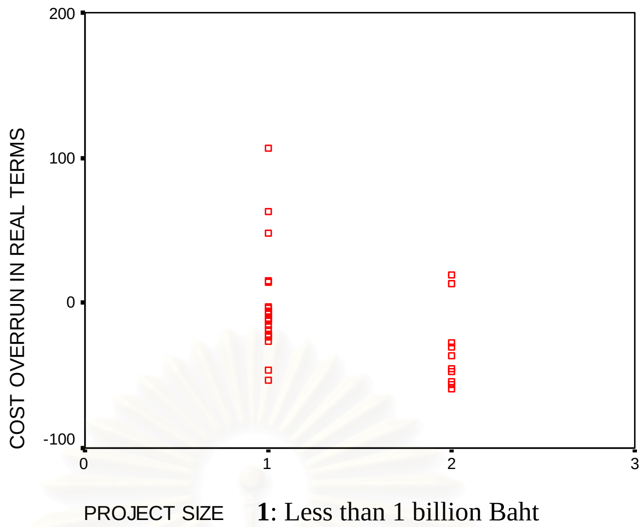


FIGURE 19. *Required Uplift for a Certain Acceptable Probability of Cost Overrun for Transportation Projects in Thailand*

After performing the analyses, it has been determined that there is no significant difference between road and bridge projects in Thailand, in terms of the cost overruns experienced. However, there may be some other factors that bring about differences in the cost overruns in transportation projects. Factors such as the project size, source of funding, and location *(urban or rural)* of transportation projects are tested in order to verify whether these factors have influence on the amount of cost overruns incurred.

Road and bridge projects from Thailand are divided into groups of projects with comparable costs. In Figure 20, it can be verified that the projects are divided into two groups, where the first group are transportation projects with costs less than one billion baht while the other group of projects includes those with costs of one billion baht and more.



1: Less than 1 billion Baht
2: 1 billion Baht and more

FIGURE 20. *Scatterplot of Transportation Projects in Thailand in Terms of Project Size*

From inspection, it can be said that the cost overrun experienced in smaller projects are somewhat bigger as compared to their counterpart. However, this claim can only be validated with the application of the independent samples t-test. In Table 12, it can be verified that the null hypothesis stating that the means of the two groups are equal can be rejected at $\alpha = 0.05$. This means that the size of the project significantly influences the amount of cost overrun incurred. By inspecting Table 13, the average cost overrun and standard deviation of the second group are less than those of the transportation projects with smaller costs. Nevertheless, it should be noted that the number of projects in the second group is small, which may not represent the population of projects in Thailand.

TABLE 12. *Independent Samples t-test for Transportation Projects in Thailand in Terms of Project Size*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
COSTOVER	**Equal variances assumed**	.353	.556	2.737	42	.009
	Equal variances not assumed			2.779	15.068	.014

TABLE 13. *Group Statistics of Transportation Projects in Thailand in Terms of Project Size*

	COST	N	Mean	Std. Deviation
COSTOVER	**Less than 1B THB**	34	-4.46	28.59
	1B THB and more	10	-32.44	27.81

After looking into the size of the projects, the project location is considered next. All the 44 transportation projects are divided into two groups according to their respective location. Projects located in urban areas are assigned to group 1 while those projects in the rural areas are assigned to group 2. This is illustrated in Figure 21.

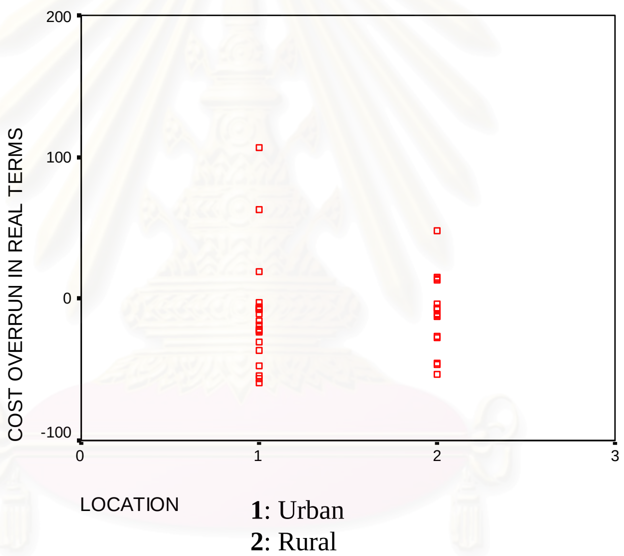


FIGURE 21. *Scatterplot of Transportation Projects in Thailand in Terms of Location*

By inspection, it can be verified in Tables 14 and 15 that there are no significant differences in the cost overruns experienced in transportation projects from both the urban and rural areas. This suggests that projects are planned, evaluated, and implemented consistently, despite the different area classifications.

TABLE 14. *Group Statistics of Transportation Projects in Thailand in Terms of Location*

	LOCATION	N	Mean	Std. Deviation
COSTOVER	**Urban**	23	-11.91	36.68
	Rural	21	-9.62	22.73

TABLE 15. *Independent Samples t-test for Transportation Projects in Thailand in Terms of Location*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
COSTOVER	**Equal variances assumed**	1.330	.255	-.246	42	.807
	Equal variances not assumed			-.251	37.167	.803

The third and last factor tested is the source of funding for all the transportation projects in Thailand. It is stated in the researcher's hypothesis that if a project is funded by a foreign institution, then it is expected that the inaccuracies are less pronounced due to the fact that there are less incentives or no incentives at all, for the foreign agencies to manipulate the figures in the project proposals. This hypothesis can be tested for the case of Thailand. Figure 22 illustrates the amount of cost overrun incurred in each of the two groups of transportation projects. There is a significantly small number of foreign funded projects in the database due to the fact that most of the transportation projects recently planned and completed are all locally funded. Nevertheless, the independent samples t-test and group statistics are given in Tables 16 and 17.

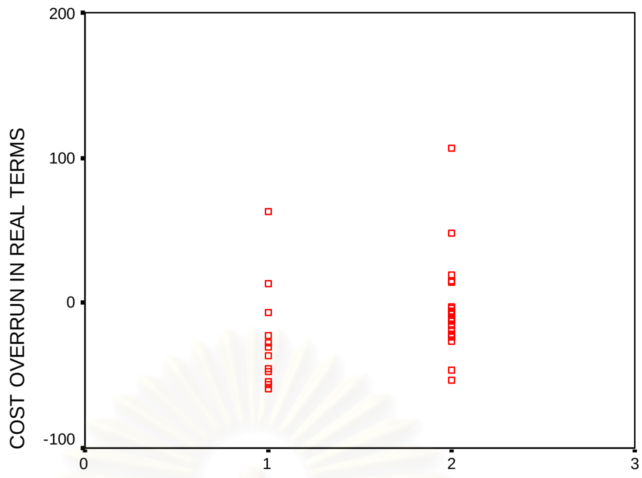


FIGURE 22. *Scatterplot of Transportation Projects in Thailand in Terms of the Source of Funding*

By inspecting Table 16, it can be verified that the two groups of projects are significantly different from each other at α = 0.05. This means that the source of funding matters when considering the cost overruns in transportation projects. Table 17 shows that the average cost inaccuracy of foreign funded projects is smaller than those of locally funded projects, supporting the hypothesis of the researcher.

TABLE 16. *Independent Samples t-test for Transportation Projects in Thailand in Terms of the Source of Funding*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
COSTOVER	**Equal variances assumed**	1.840	.182	-2.074	42	.044
	Equal variances not assumed			-1.838	16.127	.085

TABLE 17. *Group Statistics of Transportation Projects in Thailand in Terms of the Source of Funding*

	FUND	N	Mean	Std. Deviation
COSTOVER	**FOREIGN**	12	-25.8210	35.18950
	LOCAL	32	-5.1912	27.03162

In summary, transportation projects in Thailand in terms of project type and location *(urban or rural)* are indifferent from each other, in terms of cost overrun. However, there are differences in the cost overruns experienced brought about by the source of funding and the size of the projects. Looking into the source of funding of the projects, the average inaccuracy for foreign funded projects is smaller probably because of their evaluation methods, policies, and conditions. As for the size of the projects, it is surprising to find out that bigger projects have smaller cost overruns. It should be noted that there is a small number of big projects in the database and may not represent the population. Nevertheless, the difference may be brought about by the fact that bigger projects are handled by contractors from higher categories, thus ensuring the quality of work, and smooth implementation.

From the previous results, two-way analysis of variance (ANOVA) is performed in order to verify whether more specific reference classes of projects can be made. The projects are classified in terms of their size, type, source of funding, and location. All possible combinations of these 4 factors were tested for two-way ANOVA. The following are the results of the analyses.

TABLE 18. *Two-Way Analysis of Variance – Type and Project Size – Thailand*

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	6054.106(a)	2	3027.053	3.657	.035
Intercept	9853.057	1	9853.057	11.905	.001
TYPE	2.351	1	2.351	.003	**.958**
PROJECT SIZE	6040.198	1	6040.198	7.298	**.010**
Error	33933.400	41	827.644		
Total	45136.328	44			
Corrected Total	39987.506	43			

TABLE 19. *Two-Way Analysis of Variance – Type and Location – Thailand*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	57.911(a)	2	28.955	.030	.971
Intercept	4467.602	1	4467.602	4.587	.038
TYPE	.594	1	.594	.001	**.980**
LOCATION	44.002	1	44.002	.045	**.833**
Error	39929.595	41	973.893		
Total	45136.328	44			
Corrected Total	39987.506	43			

TABLE 20. *Two-Way Analysis of Variance – Type and Source of Fund – Thailand*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3719.282(a)	2	1859.641	2.102	.135
Intercept	7779.995	1	7779.995	8.795	.005
TYPE	5.045	1	5.045	.006	**.940**
SOURCE OF FUNDING	3705.373	1	3705.373	4.189	**.047**
Error	36268.224	41	884.591		
Total	45136.328	44			
Corrected Total	39987.506	43			

TABLE 21. *Two-Way Analysis of Variance – Project Size and Location – Thailand*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6108.663(a)	2	3054.332	3.696	.033
Intercept	10524.383	1	10524.383	12.737	.001
PROJECT SIZE	6051.347	1	6051.347	7.323	**.010**
LOCATION	56.909	1	56.909	.069	**.794**
Error	33878.843	41	826.313		
Total	45136.328	44			
Corrected Total	39987.506	43			

TABLE 22. *Two-Way Analysis of Variance Project Size and Source of Funding – Thailand*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6057.322(a)	2	3028.661	3.660	.034
Intercept	10526.545	1	10526.545	12.720	.001
PROJECT SIZE	2343.085	1	2343.085	2.831	**.100**
SOURCE OF FUNDING	5.568	1	5.568	.007	**.935**
Error	33930.183	41	827.565		
Total	45136.328	44			
Corrected Total	39987.506	43			

TABLE 23. *Two-Way Analysis of Variance – Source of Funding and Location – Thailand*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3724.702(a)	2	1862.351	2.106	.135
Intercept	8340.887	1	8340.887	9.431	.004
SOURCE OF FUNDING	3667.386	1	3667.386	4.146	**.048**
LOCATION	10.465	1	10.465	.012	**.914**
Error	36262.803	41	884.459		
Total	45136.328	44			
Corrected Total	39987.506	43			

In performing two-way ANOVA, it should be noted that, the other variables not included in the individual analysis do not influence the outcome or are not correlated to the variables being tested. From Tables 18 - 23, it can be seen that no two factors are significant at the same time for each time the two-way ANOVA was performed. This simply means that no further or more specific reference classes can be made for this dataset which are statistically significant. Three-Way ANOVA was also performed; however, there are a lot of groups that are empty due to small sample size. Therefore, such tests were no longer undertaken.

6.3. Case of the Philippines

6.3.1. Overview of Cost Overrun in the Philippines

A total of 85 transportation projects from the Philippines were included in the transportation database of this study. Project information for the Philippine transportation projects were gathered from different government agencies such as the DPWH and DOTC, and other institutions such as the ADB and JBIC. It can be verified from the following figure that 60 of the transportation projects from the Philippines are road projects while 25 are bridge projects.

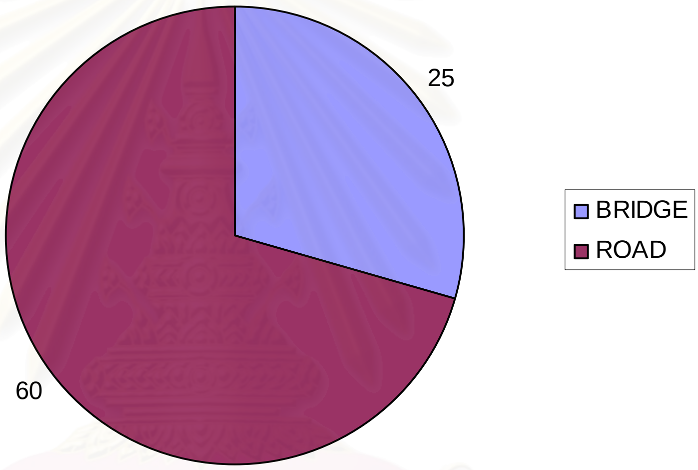


FIGURE 23. *Transportation Projects Gathered from the Philippines*

6.3.2. Classification of Cost Overrun in the Philippines

Reference Class Forecasting suggests that it is important to verify whether the two groups of samples shall be joined together or not. It is important in the case where the groups are found to be statistically different, then a more specific reference class of projects can be made; thus, a need for equality of variance and mean tests. These tests show whether the groups of samples can be considered as one or not. Following are two methods by which the tests for difference in means and variances of the two groups of sample are carried out. The first one is the method from (Washington, Karlaftis, and Mannering, 2003). Since both sample sizes are greater than or equal to 25, then there is no need for non-parametric tests and thus, the test proceeds as follows.

TABLE 24. *Group Statistics for Transportation Projects in the Philippines*

	TYPE	N	Mean	Std. Deviation	Variance
COSTOVER	Road	60	2.6978	36.20610	1310.882
	Bridge	25	11.9140	35.01795	1226.257

The descriptive statistics of COST OVERRUN, in real terms, from the two groups of samples are derived. These will then be the used as inputs in the succeeding *F* and *t* tests. The test for difference in sample variances is performed first since the test for the difference in sample means requires the assumption regarding the equality in variances. The null hypothesis for this test states that the two sample variances are equal while the alternative hypothesis states just the opposite. The test statistic used is the F^* and is given as follows. The larger sample variance is placed in the numerator and in this case the variance from the cost overrun of road projects is placed in the numerator.

$$H_o: \sigma_1^2 = \sigma_2^2$$
$$H_a: \sigma_1^2 \neq \sigma_2^2$$
$$F^*_{(n_1-1,n_2-1)} = F^*_{(59,24)} = \frac{s_1^2}{s_2^2} = \frac{1310.882}{1226.257} = 1.069$$

The critical value for a 95% level of confidence with 59 and 24 degrees of freedom is 2.0996 which is actually greater than the test statistic. This means that the null hypothesis can not be rejected at a 95% confidence level. Since the sample variances have been proved to be equal, the following equation is used to verify whether the sample means are equal or not. Again, the null and alternative hypotheses are stated as follows.

H_o: $\mu_1 - \mu_2 = 0$

H_a: $\mu_1 - \mu_2 \neq 0$

When the equality of sample variances is assumed, the test statistic for this test is given by:

$$t^* = \frac{\left(\overline{X_1} - \overline{X_2}\right) - \left(\mu_1 - \mu_2\right)}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

and the pooled variance, s_p^2, is given by:

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

Thus, substituting the values from TABLE 13 into the previous equation, it now becomes

$$s_p^2 = \frac{(60-1)1310.882 + (25-1)1226.257}{60 + 25 - 2} = 1286.412$$

$$t^* = \frac{(2.6978 - 11.9140) - 0}{\sqrt{1286.412\left(\frac{1}{60} + \frac{1}{25}\right)}} = -1.0794\,.$$

It can be verified above that the test statistic is less than the critical value t_{crit} = 1.6634 at a 95% level of confidence. This means that the null hypothesis cannot be rejected, i.e. the sample means can be considered equal. Based from the two tests performed, it can now be claimed that the two groups of samples are statistically indifferent from each other and thus should be merged upon the application of RCF.

The second method for determining whether the two groups of samples are statistically different or not is by using the SPSS software. It gives calculates all the cases possible for the groups of samples; i.e. equal or unequal variances and equal or unequal means. The following table shows the results from SPSS. It is observable that the test for the difference in sample variance is different from the one suggested by (Washington, Karlaftis, and Mannering, 2003). The test used in the SPSS software is *Levene's test for equality of variances*. It can be verified that the F value is very small and definitely less than the critical value which is also confirmed by the significance value of 0.965 which is greater than the 0.05 level of significance. Thus, it can be said that there is no statistical difference between the sample variances. Also, by looking at the columns for the test for equality of means associated with the assumption of equal variances, it can be verified that the 2-tailed significance value is greater than the 0.05 level of significance to achieve a 95% level of confidence. The tests from (Washington, Karlaftis, and Mannering, 2003) and the SPSS software both confirm that there is no reason for the two sample groups to be considered individually. Thus, the reference class of projects for the Philippines includes both road and bridge projects.

TABLE 25. *Independent Samples Test for Transportation Projects in the Philippines*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
COSTOVER	Equal variances assumed	.002	.965	-1.079	83	.284
	Equal variances not assumed			-1.095	46.397	.279

Combining the two groups of samples will yield a total of 85 sample points and the descriptive statistics are shown in TABLE 26. Looking at the row for *DELAY*, it can be seen that the minimum value is -7 meaning that the projects was completed 7 months earlier than planned while the maximum is 86 which means that the project was completed 86 months after the target completion date. Negative values for *COSTOVER* and *OVER_NOM* mean that the project was completed with money to spare or that the budget for the project was not fully spent.

TABLE 26. *Descriptive Statistics for Transportation Projects in the Philippines*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
DELAY	85	-7	86	15.16	17.829	317.877
COSTOVER	85	-66.68	166.57	5.4084	35.90183	1288.942
OVER_NOM	85	-15.89	234.18	42.8996	44.01933	1937.701
Valid N (listwise)	85					

Aside from the descriptive statistics, it is also interesting to look at the correlation matrix to find out how the variables are related to the others. In the following table, the researcher is only interested in how certain variables are related to the other variables that is why there are only few variables in the following tables. It can be verified from Table 27 that the amount of delay decreases through the years. The influence of the year when the project forecast was made on the amount of delay is substantial since the Pearson correlation coefficient is negative 0.754 and is significant at the 0.01 level. Also, the cost overrun of a project increases through the years as indicated by the positive sign of the Pearson correlation coefficient between COSTOVER and YR_FRCST. It is also shown in the graph that the correlation is significant even at the 0.01 level.

TABLE 27. *Correlation Matrix for YR_FRCST (Philippines)*

		DELAY	COSTOVER
YR_FRCST	Pearson Correlation	-.754(**)	.374(**)
	Sig. (2-tailed)	.000	.000
	N	85	85

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

TABLE 28. *Correlation Matrix for COSTOVER and DELAY (Philippines)*

		DELAY
COSTOVER	Pearson Correlation	-.235(*)
	Sig. (2-tailed)	.030
	N	85

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Scatterplots can also meaningfully aid in verifying the relationships between variables. It can be verified in Figure 24 that there seems to be a decreasing trend for the amount of delay with respect to the year the project forecast was made. Also in Figure 25, the trend of cost overrun looks to increase along with the year the project forecast was made.

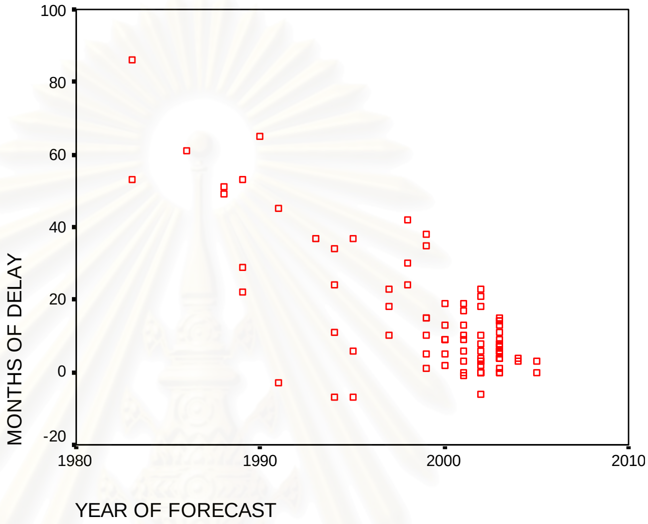


FIGURE 24. *Scatterplot for DELAY vs. YR_FRCST. in Philippine Projects*

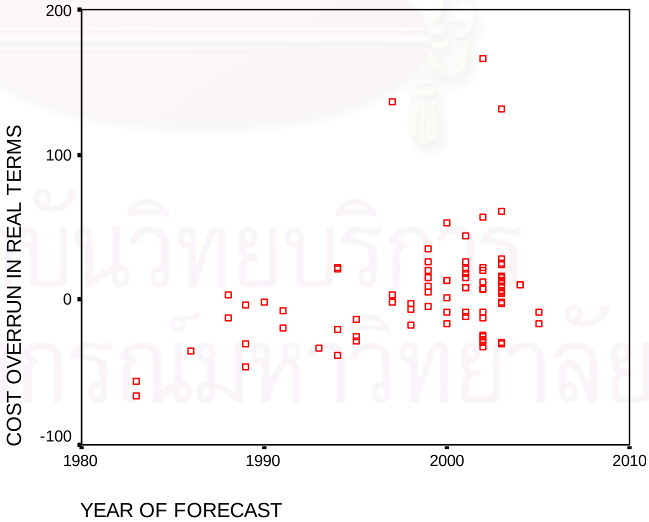


FIGURE 25. *Scatterplot for COSTOVER vs. YR_FRCST. in Philippine Projects*

The researcher added a trend line to each of the scatterplots and Figures 26 and 27 illustrate the results. Figure 26 confirms the result from the correlation analysis. It shows that the there is a reduction in delay for every year that passes. As for Figure 27, the relationship between cost overrun and the year when the project forecast was made is just the opposite. There is almost an increase in cost overrun for each year that passes.

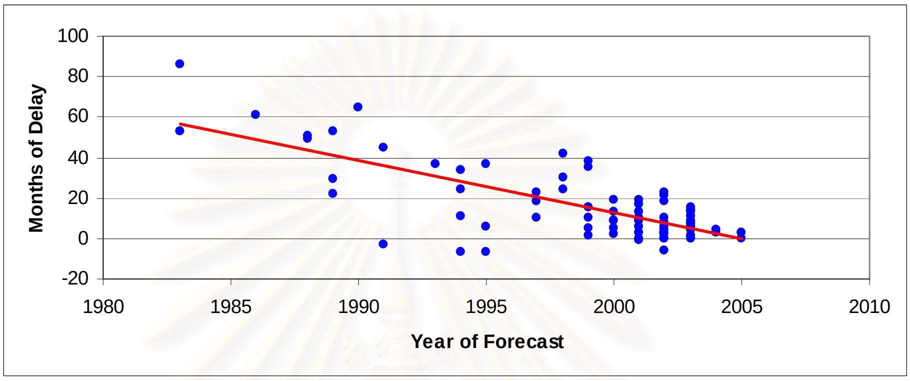


FIGURE 26. *Scatterplot for DELAY vs. YR_FRCST w/ trend line for Transportation Projects in the Philippines*

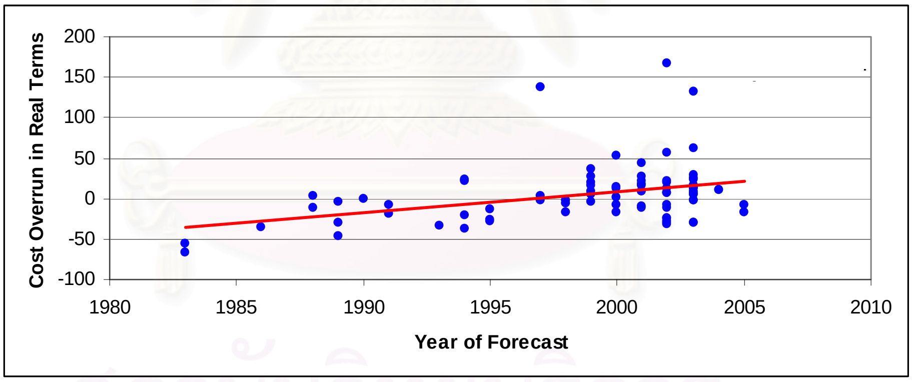


FIGURE 27. *Scatterplot for COSTOVER vs. YR_FRCST w/ trend line for Transportation Projects in the Philippines*

The following figures show the histograms for months of delay and the amount of cost overrun experienced by the transportation projects in the Philippines. It can be seen that both histograms approximate the normal curve and thus can be considered normally distributed. It is important to establish normality since it is required as an assumption in the establishment of the required uplifts for the budget to avoid cost overrun.

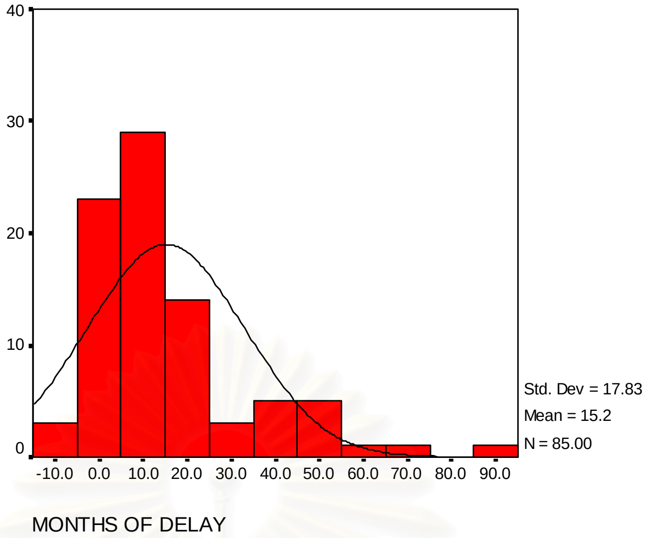


FIGURE 28. *Histogram of Months of Delay in Philippine Transportation Projects*

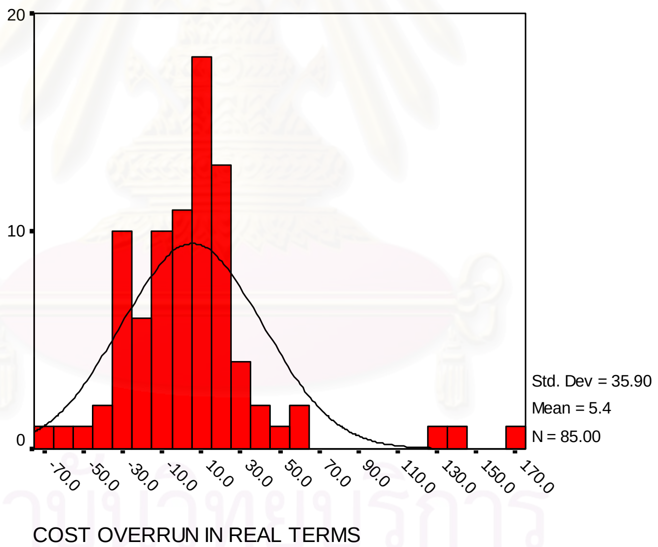


FIGURE 29. *Histogram of Cost Overrun in Philippine Transportation Projects*

The following graph is derived from Figure 29. This figure illustrates the amount of budget uplift needed for a given acceptable chance of cost overrun. It simply means that if the transportation agency responsible for the project wants to be 95% certain that cost overrun will not happen, *conversely a 5% chance of cost overrun*, then it must at least increase its budget by 58%. But if say, the transportation agency only decides to increase its budget by about 5%, then there is a 50% chance that cost overrun will or will not happen.

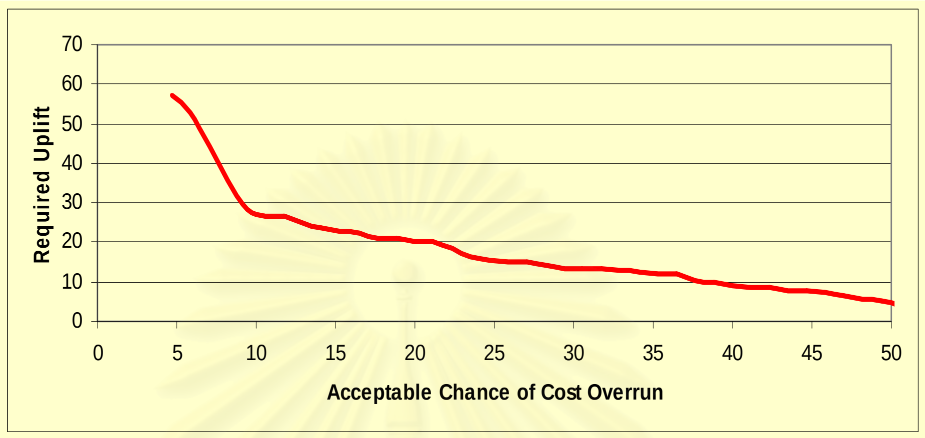


FIGURE 30. *Required Uplift for a Certain Acceptable Probability of Cost Overrun in Philippine Transportation Projects*

Aside from only considering the reference class of roads and bridges in the Philippines, there are other relevant factors that may influence the difference in cost overruns experienced in the country. It is important to find out whether the difference in size of the projects, the location, i.e. rural or urban, and the funding agencies involved in the transportation projects all have effects on the difference in the amount of cost overruns experienced.

In terms of the projected cost, the 85 road and bridge projects from the Philippines were divided into two groups. The projects were divided into groups where the first group comprises of those projects with costs less than 1 billion pesos, while the second group comprises of the projects with costs 1 billion pesos or more, all in 1995 prices. This is illustrated in Figure 31.

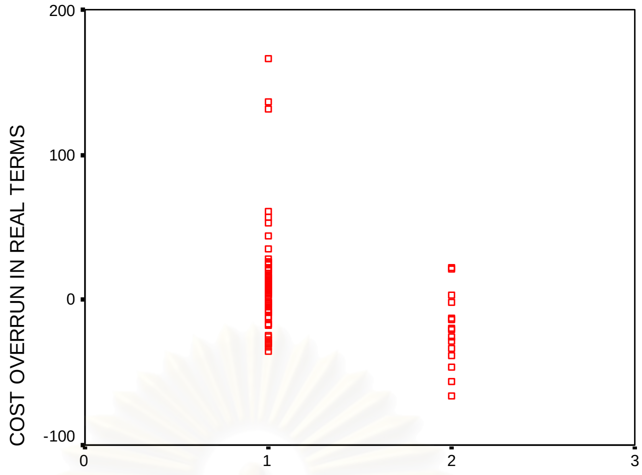


FIGURE 31. *Scatterplot of Transportation Projects in the Philippines in Terms of Project Size*

Table 29 shows the independent samples t-test for the transportation projects in the Philippines in terms of project size. It can be seen that though the variances are equal, as suggested by the high significance value, the null hypothesis stating that the means of the two groups are unequal cannot be rejected. This means that there is a significant difference between the two groups of projects in the Philippines. It suggests that project cost is relevant when dealing with cost overruns. From Table 30, it can be seen that the projects with costs 1 billion pesos or more experience less cost overruns than smaller projects. The standard deviation for the group of bigger projects is also smaller as compared to the smaller projects.

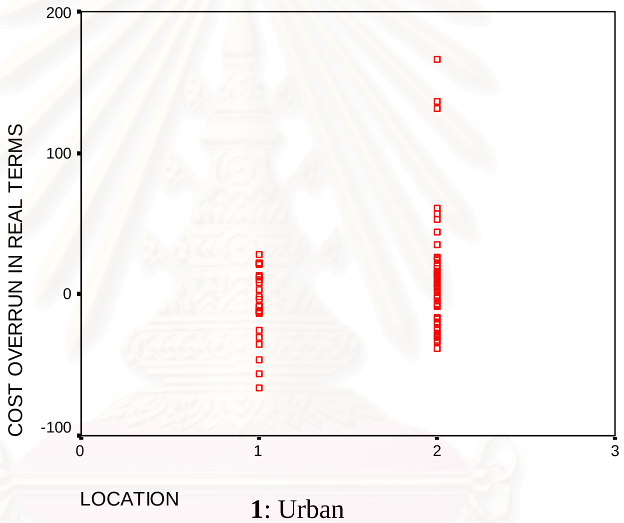
Table 29. *Independent Samples t-test for Transportation Projects in the Philippines in Terms of Project Size*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
COSTOVER	**Equal variances assumed**	.061	.806	3.327	83	.001
	Equal variances not assumed			4.081	26.764	.000

Table 30. *Group Statistics of Transportation Projects in the Philippines in Terms of Project Size*

	COST	N	Mean	Std. Deviation
COSTOVER	**Projected cost < 1 billion pesos**	70	11.08	35.36
	Projected cost ≥ 1 billion pesos	15	-21.04	25.70

In terms of the location of the transportation projects in the Philippines, the 85 road and bridge projects were again divided into two groups. The first group comprises of those projects from the urban areas, while the second group includes the projects from the rural regions. This is illustrated in Figure 32.



1: Urban
2: Rural

FIGURE 32. *Scatterplot of Transportation Projects in the Philippines in Terms of Location*

Table 31 shows the independent samples t-test for the transportation projects in the Philippines in terms of location. Though the variances are equal, as suggested by the high significance value, the null hypothesis stating that the means of the two groups are unequal cannot be rejected at the 0.05 level. This means that there is a significant difference between the two groups of projects in the Philippines. This test suggests that project location is also relevant when dealing with cost overruns. From Table 32, it can be seen that the projects from urban areas experience less cost overruns than those projects from rural areas. The standard deviation for the group of transportation projects from urban areas is also smaller as compared to the projects from the rural areas.

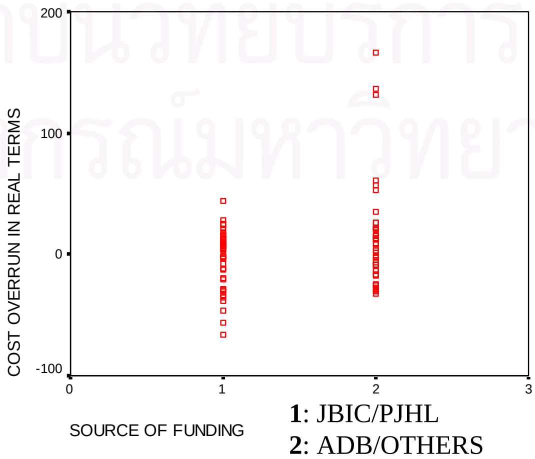
Table 31. *Independent Samples t-test for Transportation Projects in the Philippines in Terms of Location*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
COSTOVER	**Equal variances assumed**	.345	.559	-2.058	83	.043
	Equal variances not assumed			-2.429	62.094	.018

Table 32. *Group Statistics of Transportation Projects in the Philippines in Terms of Location*

	LOCATION	N	Mean	Std. Deviation
COSTOVER	**Urban**	24	-7.13	25.81
	Rural	61	10.34	38.23

The source of funding of the 85 road and bridge projects from the Philippines was also examined whether it has an effect in the difference in cost overruns experienced in the country. The 85 projects were again divided into groups where the first group comprises of those projects funded by JBIC or through the Philippine-Japan Highway Loan agreement (PJHL), while the second group includes the projects funded by ADB and other sources. This can be verified in Figure 33.



1: JBIC/PJHL
2: ADB/OTHERS

FIGURE 33. *Scatterplot of Transportation Projects in the Philippines in Terms of the Source of Funding*

Table 33 shows the independent samples t-test for the transportation projects in the Philippines in terms of the source of funding. The variances are again equal, while the means of the two groups are significantly different from each other. This test suggests that the different sources of funding influence the amount of overrun in the country. From Table 34, it can be seen that the projects funded by JBIC/PJHL experience less cost overruns than those projects from other funding sources. The standard deviation for the JBIC/PJHL projects is also smaller as compared to the projects from other funding institutions.

Table 33. *Independent Samples t-test for Transportation Projects in the Philippines in Terms of the Source of Funding*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
COSTOVER	**Equal variances assumed**	1.810	.182	-2.185	83	.032
	Equal variances not assumed			-2.276	74.535	.026

Table 34. *Group Statistics of Transportation Projects in the Philippines in Terms of the Source of Funding*

	FUND	N	Mean	Std. Deviation
COSTOVER	**JBIC/PJHL**	39	-3.63	24.69
	ADB/OTHERS	46	13.07	41.96

In summary, the cost overruns in transportation projects in the Philippines are not affected by the project type, i.e. roads and bridges. However, there are other factors that have been tested to explain the differences in the cost overruns experienced in the transportation projects. Through the application of the independent samples t-test, it has been determined that factors such as the location *(urban or rural)*, project size *(projected cost less than 1 billion pesos or more)*, and the source of funding, all have significant effects on the amount of cost overrun experienced. Projects from the urban areas have less cost overruns probably because of better project monitoring, known site conditions, quality of contractors, and many other factors that affect the cost of the projects. Bigger or more expensive projects also experience less cost overruns when compared to less expensive projects probably because bigger projects often have international consultants and longer planning stages or evaluations. Lastly, projects funded by JBIC/PJHL have less cost overruns when compared to other funding agencies. This may be attributed to the different JBIC consultants and numerous evaluations such as feasibility studies and ex-post evaluations.

From these results, two-way analysis of variance (ANOVA) is performed in order to verify whether more specific reference classes of projects can be made. The projects are classified in terms of their size, type, source of funding, and location. All possible combinations of these 4 factors were tested for two-way ANOVA. The following are the results of the analyses.

TABLE 35. *Two-Way Analysis of Variance – Project Size and Type – Philippines*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13526.342(a)	2	6763.171	5.853	.004
Intercept	475.905	1	475.905	.412	.523
PROJECT SIZE	12027.433	1	12027.433	10.410	**.002**
TYPE	786.911	1	786.911	.681	**.412**
Error	94744.759	82	1155.424		
Total	110757.430	85			
Corrected Total	108271.102	84			

TABLE 36. *Two-Way Analysis of Variance –Type and Location – Philippines*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7928.951(a)	2	3964.476	3.240	.044
Intercept	851.868	1	851.868	.696	.407
TYPE	2671.727	1	2671.727	2.183	**.143**
LOCATION	6430.041	1	6430.041	5.255	**.024**
Error	100342.150	82	1223.685		
Total	110757.430	85			
Corrected Total	108271.102	84			

TABLE 37. *Two-Way Analysis of Variance – Type and Source of Funding – Philippines*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6976.972(a)	2	3488.486	2.824	.065
Intercept	2825.916	1	2825.916	2.288	.134
TYPE	1086.583	1	1086.583	.880	**.351**
SOURCE OF FUNDING	5478.062	1	5478.062	4.435	**.038**
Error	101294.129	82	1235.294		
Total	110757.430	85			
Corrected Total	108271.102	84			

TABLE 38. *Two-Way Analysis of Variance – Location and Project Size – Philippines*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13661.891(a)	2	6830.945	5.921	.004
Intercept	1479.120	1	1479.120	1.282	.261
LOCATION	922.460	1	922.460	.800	**.374**
PROJECT SIZE	8404.666	1	8404.666	7.285	**.008**
Error	94609.211	82	1153.771		
Total	110757.430	85			
Corrected Total	108271.102	84			

TABLE 39. *Two-Way Analysis of Variance – Project Size and Source of Funding – Philippines*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14605.930(a)	2	7302.965	6.393	.003
Intercept	796.846	1	796.846	.698	.406
PROJECT SIZE	8715.540	1	8715.540	7.630	**.007**
SOURCE OF FUNDING	1866.499	1	1866.499	1.634	**.205**
Error	93665.172	82	1142.258		
Total	110757.430	85			
Corrected Total	108271.102	84			

TABLE 40. *Two-Way Analysis of Variance – Source of Funding and Location – Philippines*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10096.805(a)	2	5048.402	4.217	.018
Intercept	127.600	1	127.600	.107	.745
SOURCE OF FUNDING	4839.580	1	4839.580	4.042	**.048**
LOCATION	4206.415	1	4206.415	3.513	**.064**
Error	98174.297	82	1197.248		
Total	110757.430	85			
Corrected Total	108271.102	84			

Again, it should be noted that the other variables not included in the individual analysis do not influence the outcome or are not correlated to the variables being tested when performing two-way ANOVA. From Tables 35-40, it can be seen that no two factors are significant, $\alpha = 0.05$, at the same time for each time the two-way ANOVA was performed. This simply means that no further or more specific reference classes can be made for this dataset which are statistically significant. However, results found in Table 40 are somewhat significant when the value of α is increased to at least 0.07. This means that the source of funding and location can be used as a more specific class of transportation projects in the Philippines and that both these factors affect the amount of cost overrun experienced. Table 41 shows the descriptive statistics of the cost overrun grouped according to source of funding and location. It can be seen that urban transportation projects experience less cost overrun than rural projects. Moreover, urban projects from JBIC/PJHL experience less cost overrun than transportation projects funded by ADB/Others. A bigger database may reveal other more specific reference classes of transportation projects. Again, it should be noted that the results should be used with caution due to the small sample size of the research. The actual characteristics of the population may not well be represented by the database included in this research.

Three and four way ANOVA were also performed; however, there are a lot of groups that are empty due to small sample size. Therefore, such tests were no longer undertaken.

TABLE 41. *Descriptive Statistics of Cost Overrun in Transportation Projects in the Philippines Grouped according to Source of Funding and Location*

SOURCE OF FUNDING	LOCATION	Mean	Std. Deviation	N
JBIC/PJHL	Urban	-12.1015	30.16919	13
	Rural	.6021	20.82089	26
	Total	-3.6324	24.68674	39
ADB/OTHERS	Urban	-1.2536	19.24462	11
	Rural	17.5763	46.19366	35
	Total	13.0735	41.95822	46
Total	Urban	-7.1296	25.81445	24
	Rural	10.3414	38.22892	61
	Total	5.4084	35.90183	85

6.4. Overall Results

Since it has already been discussed that road and bridge projects in both Thailand and the Philippines should be combined, the task now is to find out whether transportation projects in the two countries should be considered independently of each other or shall they be analyzed together. Thus, there is a need for the test of equality of independent samples. Since, Indonesia only has six transportation projects included in the database, only Thailand and the Philippines will have this test. Table 42 summarizes the results of the independent samples t-test. It can be verified that there is no significant difference in the variance, in term of cost overrun, of the transportation projects from the two countries. However, as one looks at the test for the equality of means, the t-value is greater than 2 with an associated p-value of 0.012. This means that the average cost overruns in the two countries are significantly different from each other. Thus from this result, the transportation projects from the two countries shall be considered separately.

TABLE 42. *Independent Samples t-test for All Transportation Projects*

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
COSTOVER	**Equal variances assumed**	.598	.441	2.557	127	.012
	Equal variances not assumed			2.693	100.386	.008

TABLE 43. *Descriptive Statistics for All Transportation Projects*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
DELAY (months)	100	-7	86	16.26	17.823	317.669
COSTOVER (%)	135	-66.68	166.57	-.1537	36.50751	1332.798
OVER_NOM	135	-53.93	273.85	29.6469	49.23716	2424.298

But for the purpose of discussion, all the transportation projects in the database were combined. There are a total of 135 transportation projects, 85 of which are from the Philippines, 44 from Thailand, and 6 from Indonesia. Table 43 summarizes the descriptive statistics for all of the projects included. From this table, it can be said that wherever the project is located in each of the three countries considered, road and bridge projects are expected to be with in the planned budget since the average cost overrun in real terms is close to zero. However, road and bridge projects have an average of 16.26 months of delay in project completion. The histograms for the amount of delay and cost overrun in real terms are shown in Figures 34 and 35. Both graphs approximate the normal curve.

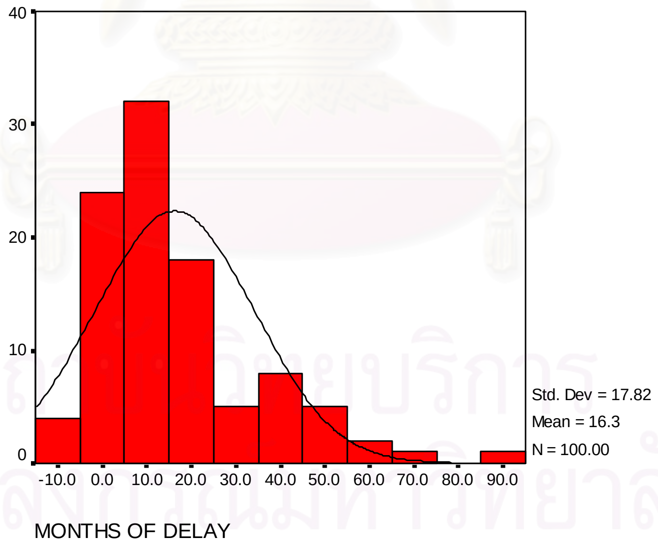


FIGURE 34. *Histogram of Months of Delay for All Transportation Projects*

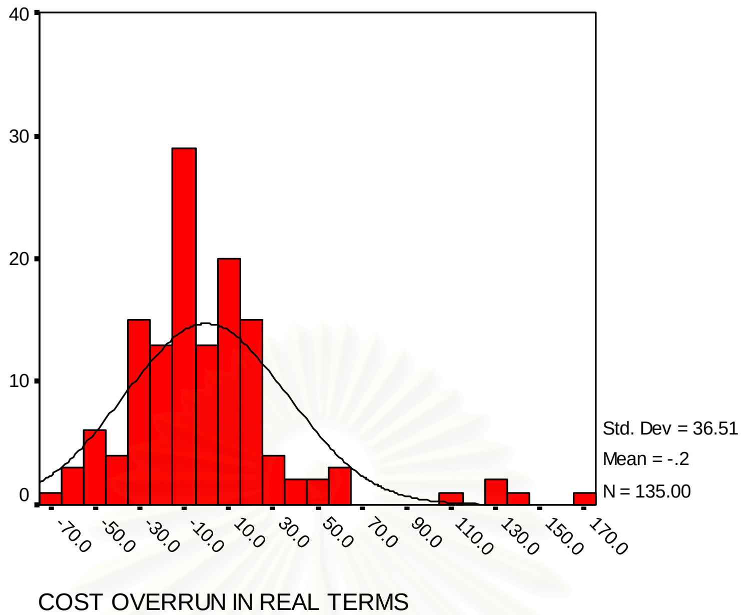


FIGURE 35. *Histogram of Cost Overrun in Real Terms for All Transportation Projects*

It is also interesting to look at the trend of delay experienced and cost overruns through the years, if there is any. Figure 36 clearly shows that there is a decreasing trend in the amount of delay in the transportation projects. There is a reduction in delays per year. On the other hand, there is an increasing cost overrun through the years.

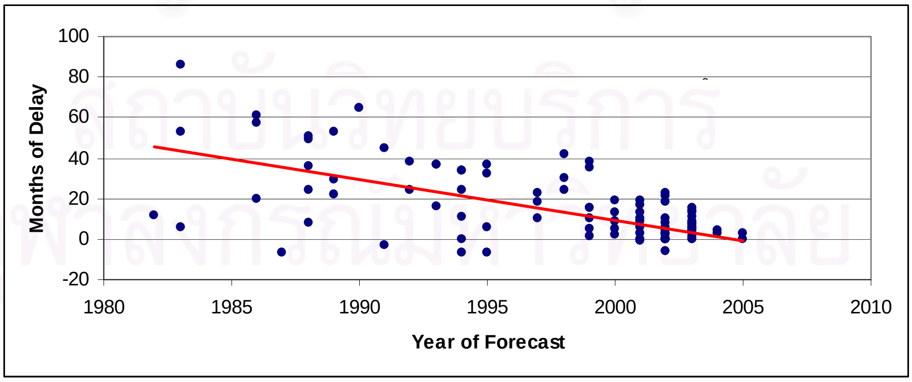


FIGURE 36. *Scatterplot of DELAY vs. YR_FRCST with Trend line for All Transportation Projects*

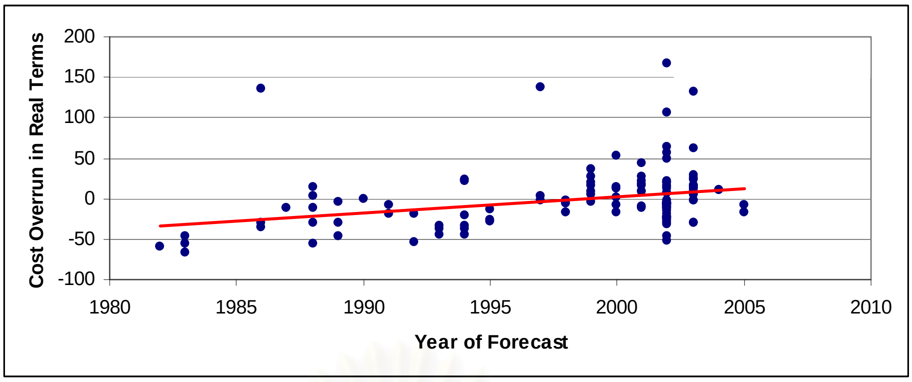


FIGURE 37. *Scatterplot of COSTOVER vs. YR_FRCST with Trend line for All Transportation Projects*

From Figure 37, it is now possible to derive the required increase in budget to be confident at a certain probability that cost underestimation will not happen. The result can be seen in Figure 38. From this figure, it can be verified that at 5% acceptable chance of cost overrun, at least 58% percent should be added to the original budget; also at a 15% acceptable chance that cost underestimation will happen, 21% should be added to the budget. Different budget increases associated with different probabilities of cost overrun happening, can be derived from this graph.

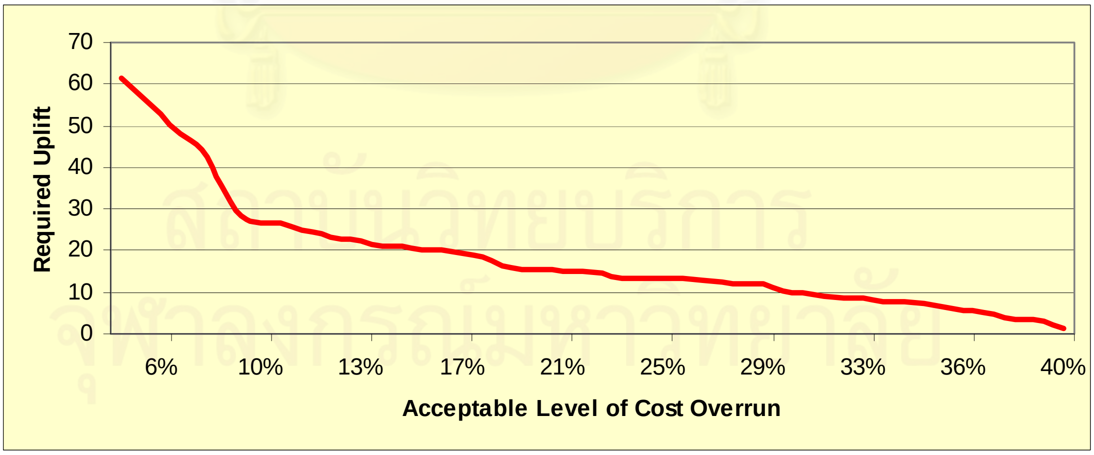


FIGURE 38. *Required Uplift for a Certain Acceptable Probability of Cost Overrun for All Transportation Projects*

6.5. Comparison with Previous Studies

The database assembled in this research consists of 135 road and bridge projects from three countries in South East Asia namely Indonesia, Thailand, and the Philippines. From the 135 project, 6 are from Indonesia, 44 from Thailand, and 85 from the Philippines. The costs of the projects considered in this research are at least two million dollars. The projects considered are a bit small as compared to the projects in Flyvbjerg's database. Also, Flyvbjerg's database consists of 33 bridge projects and 167 road projects, definitely a larger sample size. His results are summarized in Table 44 while the results of this research are summarized in Table 45.

TABLE 44. *Descriptive Statistics of Flyvbjerg's Database*

Type of project	No. of cases (N)	Avg. cost overrun %	Standard deviation
Rail	58	44.7	38.4
Bridges and tunnels	33	33.8	62.4
Road	167	20.4	29.9

Source: Flyvbjerg (2005)

Flyvbjerg's database of transportation projects also has the following additional characteristics (Flyvbjerg, 2005).

- The 258 transportation projects included in his database is approximately worth 90 billion US dollars in 1995 prices.
- The price range of the transportation projects is from $1.5 million to about $8.5 billion in 1995 prices.
- The transportation projects included are completed between the years 1927 and 1998 to show whether forecasts have improved over time.
- The transportation projects in the database can be found in 20 countries *(developed and developing)* in 5 continents.

TABLE 45. *Descriptive Statistics of Current Database*

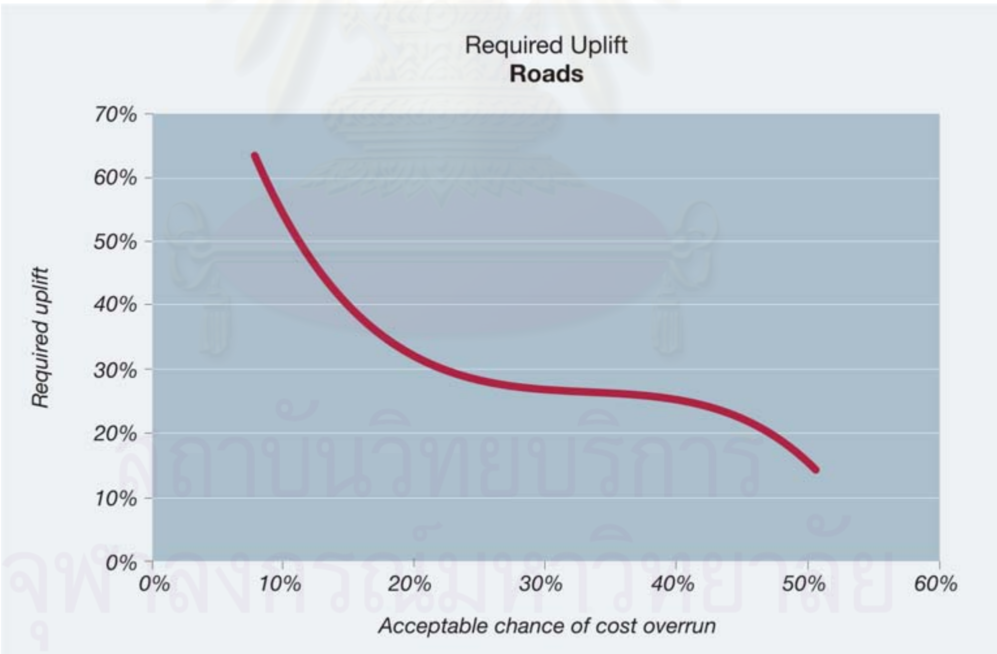
Type of project	No. of cases (N)	Avg. cost overrun %	Standard deviation
Bridges	41	2.3	35.1
Road	94	-1.2	37.24

The transportation projects database of the current research also has the following additional characteristics.

- The 135 transportation projects included in his database is approximately worth 4.8 billion US dollars in 1995 prices.
- The price range of the transportation projects is approximately from $1.9 million to about $493 million in 1995 prices.
- The transportation projects included are completed between the years 1987 and 2007.
- The transportation projects in the database can be found in only 3 countries in the South East Asian region.

As seen in Tables 44 and 45, the results are different. The average cost overrun experienced of transportation projects in the three selected South East Asian countries are definitely smaller than those projects included in Flyvbjerg's database. The standard deviation for bridges is also smaller indicating a narrower range of inaccuracy. However, the standard deviation for the cost overrun experienced in road projects is larger as compared to Flyvbjerg's. Anyway, smaller cost overruns are better but this does not necessarily mean that forecasts made for projects in the selected countries in the ASEAN region are better. There are a lot of factors that may affect the accuracy of cost forecasts. The first that can be thought of is the size of the projects. The projects in Flyvbjerg's database are larger in size and thus, more expensive. Larger projects entail more uncertainty due to the larger scope of the projects. Also, the technology involved in the construction of the projects may have great influence on the cost of the projects. Differences in the funding mechanism may also affect the accuracy of forecasts. From the researcher's experience in data gathering, many big projects in the Philippines are funded by international funding institutions such as the ADB, JBIC, and World Bank as loans. When the projects are implemented this way, the projects pass through several consultants to check the cost estimates and designs. As for Thailand, the situation is just the opposite since most of the projects are government funded.

Figures 39 to 42 show the required uplifts for certain acceptable levels of cost overrun. Figure 39 is first compared with Figure 40. It can be seen that the required uplifts established for road projects in the selected South East Asian countries are much smaller than those found in Figure 39 by Flyvbjerg. Also, the lowest value from which an applicable uplift is necessary, Figure 40, is at the 40% mark while the Flyvbjerg recommends about a 13% of uplift in budget at the 50% mark. This comparison can also be made in Figures 41 and 42. There are lower values of uplift for the proposed bridges in the region as compared to those in Europe.



(Source: Flyvbjerg and COWI, 2004)

FIGURE 39. *Flyvbjerg's Required Uplift for a Certain Acceptable Probability of Cost Overrun – Roads*

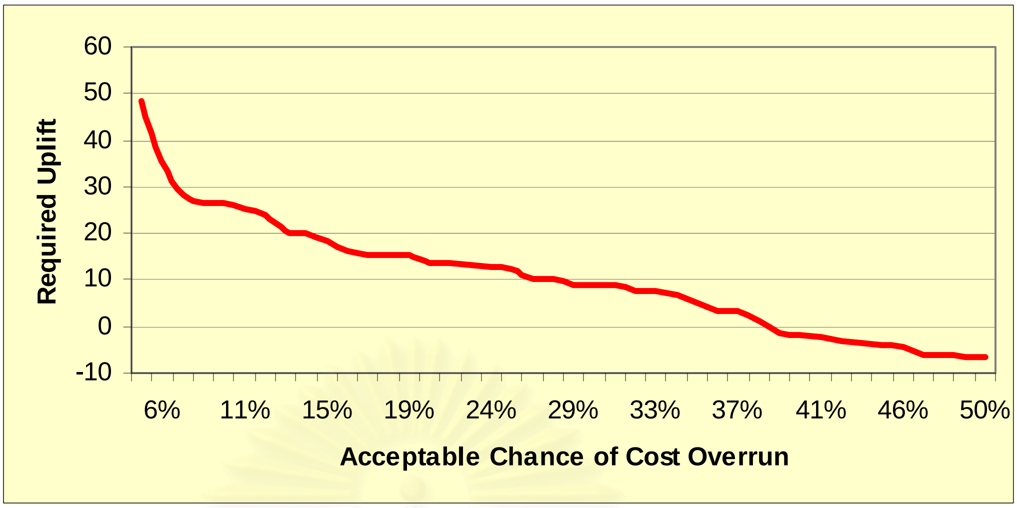
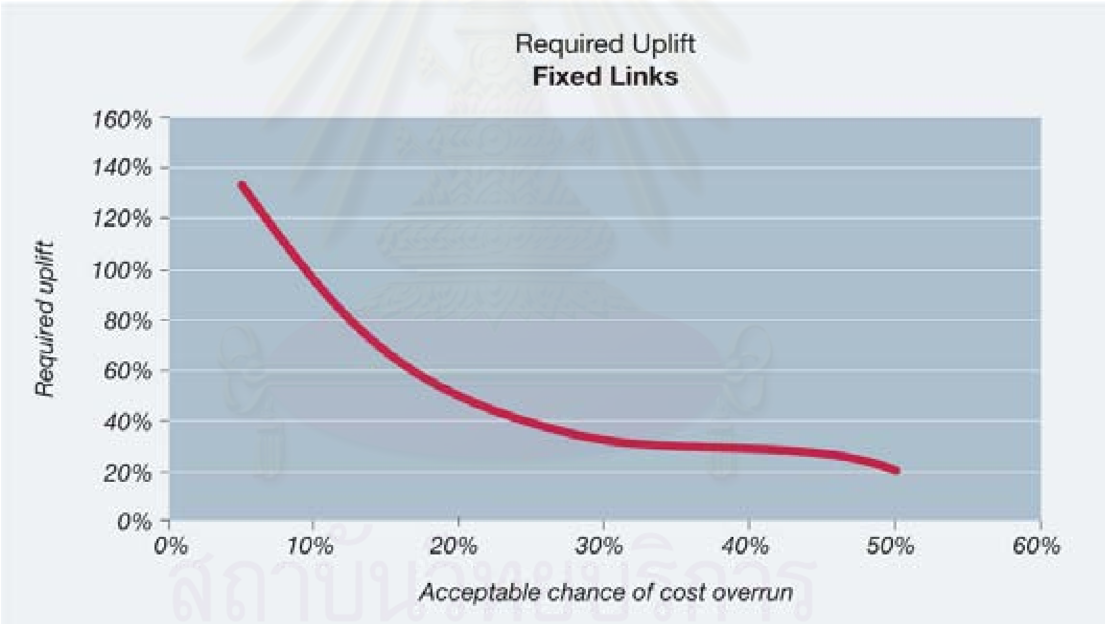


FIGURE 40. *Required Uplift for a Certain Acceptable Probability of Cost Overrun – Roads*



(Source: Flyvbjerg and COWI, 2004)

FIGURE 41. *Flyvbjerg's Required Uplift for a Certain Acceptable Probability of Cost Overrun – Fixed Links*

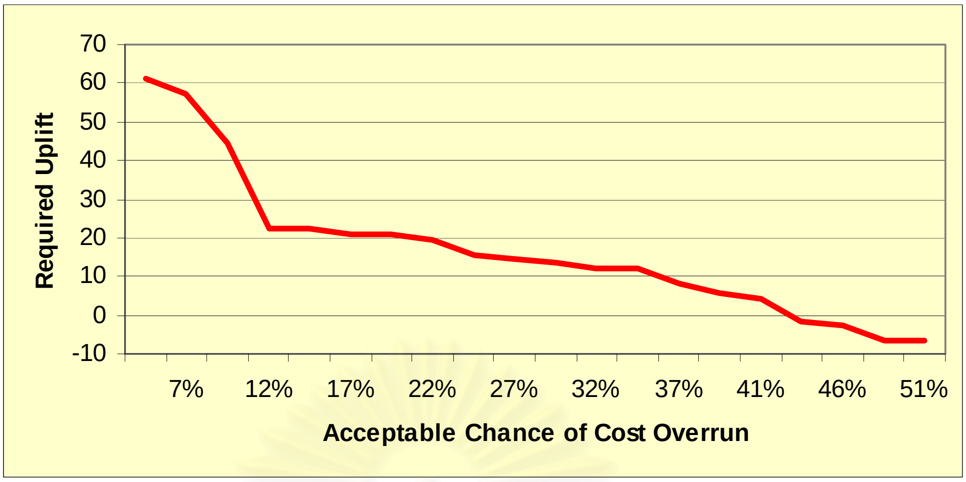


FIGURE 42. *Required Uplift for a Certain Acceptable Probability of Cost Overrun – Fixed Links*

CHAPTER VII

CONCLUSION AND POLICY IMPLICATIONS

From the several feasibility studies reviewed from the JICA library, it can be said that B/C is the commonly used method for financial analysis and that the four-step model is the common method used in preparing traffic demand forecasts. But, aside from these similarities, there are also some differences. The items included in the cost and benefits of the projects differ. Some projects considered the project construction costs while others did not. Also, in some projects, there were certain criteria that were included aside from the quantifiable benefits and costs such as the social and environmental impacts, aesthetics, and construction risk. There is also a lack of traffic surveys in the feasibility studies reviewed. Interviews and surveys are important for they are the foundations from which the forecasts are made. From the experience of the researcher in data gathering, it can be said that most transportation projects do not have the projected ridership. This is the reason why the demand aspect of the transportation projects in the region was not included in this research.

As discussed, the transportation planning practices in both Thailand and the Philippines are somewhat similar. Transportation projects in both countries undergo similar project development cycles and the criteria for the evaluation of projects are also comparable. However, there is insufficient evidence for any categorical statement to be made with regards to which planning practice in the two countries is more systematic. Again, it should be noted that various criteria and processes for the different specific types of transportation projects promote efficiency in the performance and completion of the different tasks in the transportation planning sector, as mentioned in previous studies.

After completing the analysis for the transportation projects in selected South East Asian Countries, it has been found that there are no significant differences, in term of cost overrun, between road and bridge projects in both Thailand and the Philippines, respectively. However, further analyses show that cost overrun in transportation projects in Thailand and Philippines are significantly different from each other. As for the case of Indonesia, nothing much can be said due to small sample size. Table 46 summarizes the results of the analysis and can be directly compared with Flyvbjerg's results as seen in Table 44.

TABLE 46. *Summary Table of Cost Overrun and Delay of Transportation Projects in Selected South East Asian Countries*

Country	Project	Cost Overrun in Real Terms (%)		Delay (in months)	
		Mean	Variance	Mean	Variance
All	Road	-1.2	1386.82	19.11	376.073
		N = 94		*N = 71*	
	Bridge	2.3	1232.01	9.28	111.85
		N = 41		*N = 29*	
Philippines	Overall	5.4084	1288.942	15.16	317.877
		N = 85		*N = 85*	
	Road	2.6978	1310.882		
		N = 60			
	Bridge	11.9140	1226.257		
		N = 25			
Thailand	Overall	-10.8175	929.942	24.22	131.444
		N = 44		*N = 9*	
	Road	-10.4132	943.087		
		N = 29			
	Bridge	-11.5993	969.082		
		N = 15			
Indonesia	Overall	-0.7483	4540.174	19.83	589.367
		N = 6		*N = 6*	

A previous study of Flyvbjerg also showed that nine out of ten transportation projects in his database experienced cost overrun. He also added that 84% of these projects have cost forecasts that are wrong by more than ±20% (Flyvbjerg, 2005). These figures can be compared with what has been found in the selected countries in the region. Considering all the 135 transportation projects included in the database, 41% experience cost overruns, much lower than the result of the previous study which is 90%. Table 47 summarizes the accuracy of forecasts in each of the countries.

TABLE 47. *Percentage of Transportation Projects with Cost Overrun within the* ±20% Range

Country	Cost Overrun within ± 20%
Indonesia	33%
Thailand	59%
Philippines	58%
All	57%

From Table 47, it can be seen that almost 50% of the forecasts are correct within the ±20% range. This is again a good indication that forecasts in the region are more accurate as compare to the results of previous studies. Also, as seen in Figure 37, the cost overruns experienced in the regions are scattered unsystematically, indicating that cost forecasts are not manipulated to satisfy the economic viability of the projects.

It has been shown that the forecast inaccuracies found in the selected countries in South East Asia are much smaller in magnitude and less frequent as compared to those found from previous studies. However, due to the small sample size of the database in this study, it may not be a representative of the population used and thus the results should be interpreted with caution. Also, most of the projects considered in this research are funded by international agencies such as the ADB, World Bank, and JBIC. Thus, locally funded projects and PPP projects are not well represented in the database. It is recommended that a bigger and more diverse database of transportation projects be assembled for South East Asia in order to establish more credible budget uplifts for transportation projects and to better assess the condition of forecast inaccuracies in the region.

The comparison between the transportation projects database of this study and Flyvbjerg's database is shown in Table 48. It can be verified that Flyvbjerg's database is bigger and more diverse. There are more projects included in his database, there are more project types considered, and that the project size in terms of the project cost is much bigger when compared to the database of the current study. In this research, it has been shown that project size, source of funding, and location *(urban or rural)* influence the amount of cost overruns experienced. The difference between the two databases in terms of the said factors may have caused the differences in the results. Thus, the results of this research should be used and interpreted with caution. The budget uplifts established in this study is only applicable to specific project types and size. No further reference classes were established due to the restrictions caused by the sample size.

TABLE 48. *Comparison of Current Database and Flyvbjerg's Database*

	Current Database	**Flyvbjerg's Database**
Number of projects included in the database	135	258
Type of projects in the database	Roads and Bridges	Roads, Bridges, Tunnels, and Rail
Price Range of Projects	\$1.9 million - \$493 million (1995 prices)	\$1.5 million - \$8.5 billion (1995 prices)
Year of Completion of Projects	1987 - 2007	1927 - 1998
Location of Projects	3 countries	20 countries *(developed and developing)*

Traffic forecast inaccuracies were not included in this study due to difficulties encountered in data gathering. Many projects do not have traffic forecasts and simply rely on *"before and after"* traffic counts to verify the effects of the projects. Comparison of the actual and forecasted demand was not performed due to the following difficulties encountered in data gathering.

- The units of the forecasted and actual values do not match.
- The traffic count stations mentioned in the study are different from the actual counting stations along stretches of roads.
- Due to delays, the forecasted opening year mentioned in the study does not match the actual opening year which means that certain assumptions of the study are not satisfied.
- There are no traffic forecasts made for most projects.

The researcher also suggests that there should be more ex-post evaluations performed on major transportation projects, just like what JBIC does with some of its projects, to determine their performance as compared to the forecasts.

Despite the seemingly good results of this study, a number of things need careful consideration. First of all, the cost overrun experienced in the region should be monitored continuously. From the results of the analysis presented, it appears that trend is increasing and thus requires attention. Also, the general public should be cautious of what happens with the transportation projects planned and constructed. A system of checks and balances should be employed in order to determine whether resources were used efficiently or not. The government should also promote transparency in order to get the public more involved, and to gain their trust and respect. The government should also advocate the practice of ex-post evaluation in transportation projects. But since most transportation projects do not have demand forecasts, this should be included in the reform of the transportation planning process in the South East Asian region. Though traffic surveys and interviews are a bit costly, it is only through these comparisons of the actual and forecasted values can all the costs and benefits be weighed. Ex-post evaluations show how the investments perform as compared to the forecasts. Thus, such evaluations can aid government agencies on how to allocate resources more efficiently. It may seem that the suggestions offered to the government are demanding but such revisions are simply for the betterment of society.

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APPENDICES

CASE OF INDONESIA

All information regarding transportation projects in Indonesia were gathered from JBIC alone. As seen in Figure 43, there are only 6 transportation projects included in the database of transportation projects; 5 of which are road projects and one bridge project. The small number of samples is due to the difficulties encountered in data gathering. Several agencies were contacted but the researcher barely received responses from them. Also, the researcher was not able to go to Indonesia to personally collect data from private and government agencies due to lack of contacts.

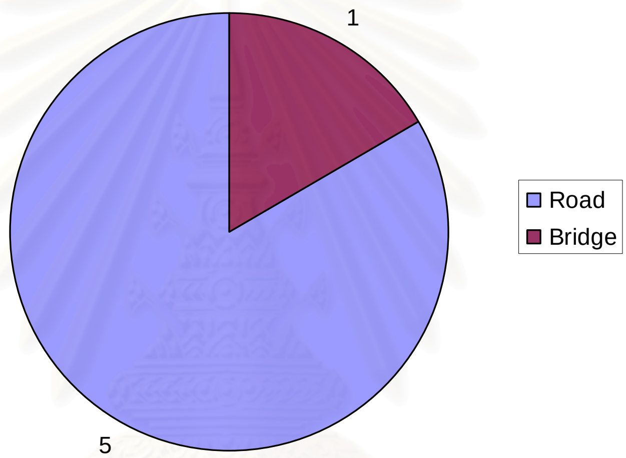


FIGURE 43. *Transportation Projects from Indonesia*

Due to the small sample size, no further sub divisions can be made and the conclusions that will be derived from the analysis yield very little statistical significance. Nevertheless, the descriptive statistics are shown in TABLE 36. A negative value for the moths of delay means that the project was completed ahead of schedule. Also, a negative value for cost overrun means that the project was completed within budget.

TABLE 36. *Descriptive Statistics of Transportation Projects in Indonesia*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
DELAY	6	-7	57	19.83	24.277	589.367
COSTOVER	6	-44.85	134.75	-.7483	67.38081	4540.174
OVER_NOM	6	-15.47	273.85	54.7686	109.30767	11948.168

It is also interesting to look at the correlation matrix to examine the possible relationships between variables. However, as one looks at TABLE 37, there are no significant correlations between any two variables at the 95% level of confidence. Though it seems that both delay and cost overrun decreases through time, their significance values are a bit high to be considered. This may have changed had the sample size been bigger. Also, by looking at the scatterplot for the number of months of delay in FIGURE 44, no obvious pattern can be detected. However, as the trend line suggests, the trend is decreasing. On the other hand, the scatterplot and trendline in FIGURE 45 for cost overrun with respect to the year of forecast shows a decrease in cost overrun every year. Then again, nothing much with statistical significance can be said due to the small sample size.

TABLE 37. *Correlation Matrix for Transportation Projects in Indonesia*

		DELAY	COSTOVER	OVER_NOM
YR_FRCST	Pearson Correlation	-.155	-.654	-.565
	Sig. (2-tailed)	.770	.159	.243
	N	6	6	6

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

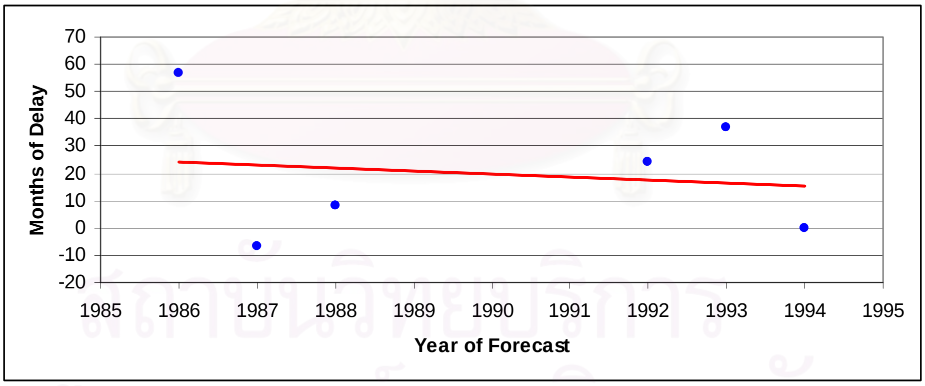


FIGURE 44. *Scatterplot for DELAY vs. YR_FRCST. w/ trendline for Transportation Projects in Indonesia*

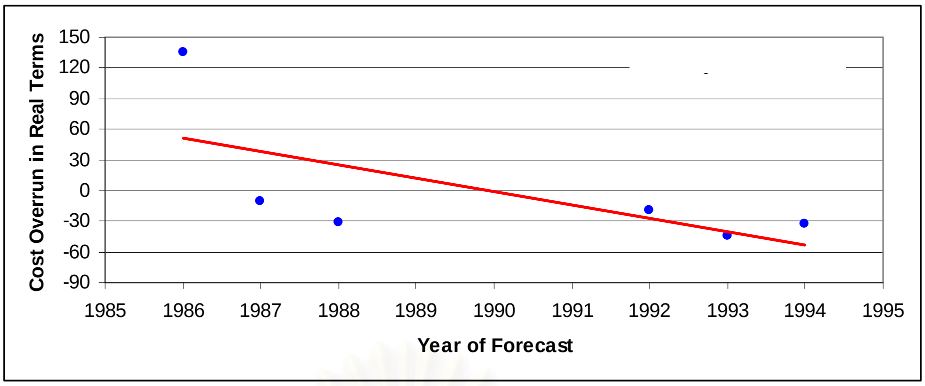
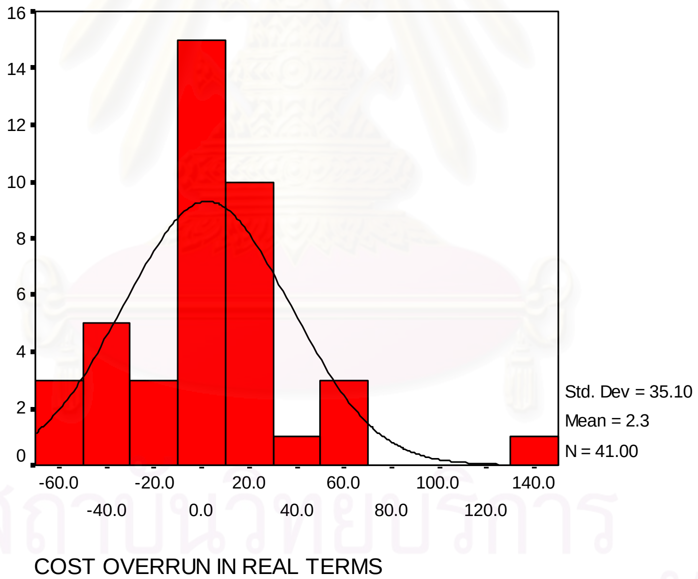


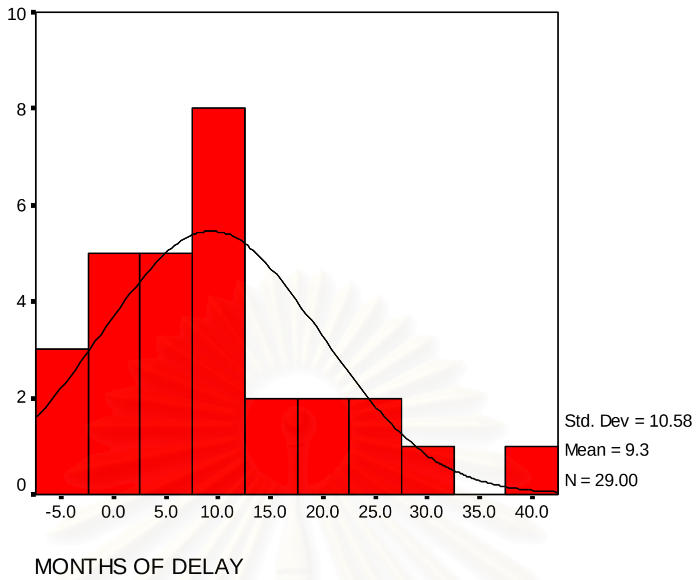
FIGURE 45. *Scatterplot for COSTOVER vs. YR_FRCST. w/ trendline trendline for Transportation Projects in Indonesia*

HISTOGRAMS

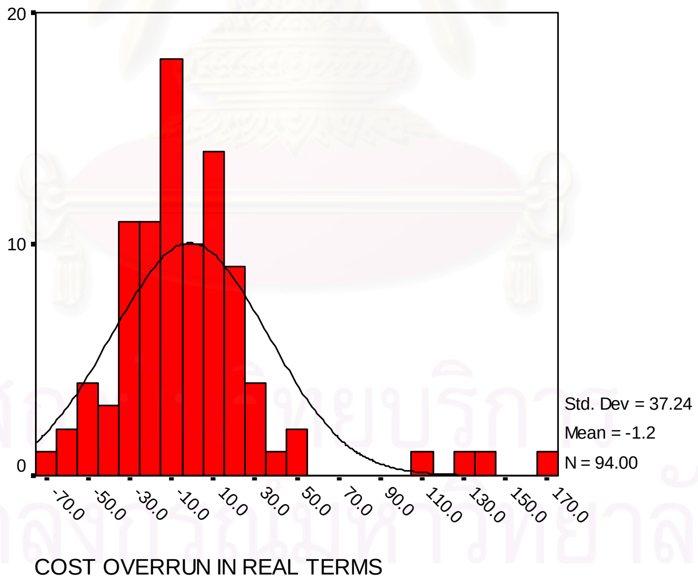
Histogram of Cost Overrun for All Bridges in the Database



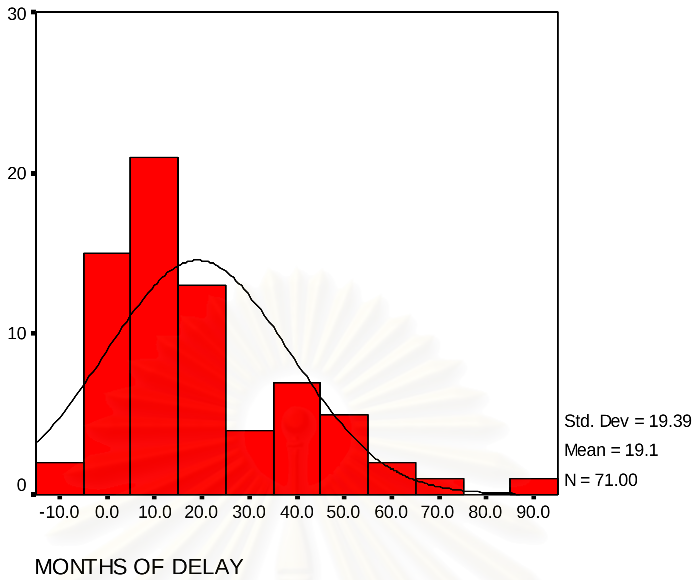
Histogram of Delay for All Bridges in the Database



Histogram of Cost Overrun for All Roads in the Database



Histogram of Delay for All Roads in the Database



BIOGRAPHY

Nicanor R. Roxas, Jr. was born on December 26, 1981 in Tanza, Cavite, a province south of Manila. Mr. Roxas finished his bachelor's degree in Mathematics major in Business Applications in 2001 at De La Salle University - Manila. He then taught in a Kumon Center, the largest math and language educational system in the world. After four months of teaching, he decided to take another degree, this time in Civil Engineering in the same university. He finished the said degree in October 2005. His undergraduate research dealt with a new public transport mode proposed for Metro Manila. Influenced by his undergraduate thesis adviser, Dr. Alexis Fillone, he applied for a scholarship under the ASEAN University Network / Southeast Asia Engineering Education Development Network (AUN/SEED-Net) Scholarship of JICA. Mr. Roxas went directly to Chulalongkorn University after passing the CE Board Licensure Examinations in May 2007.